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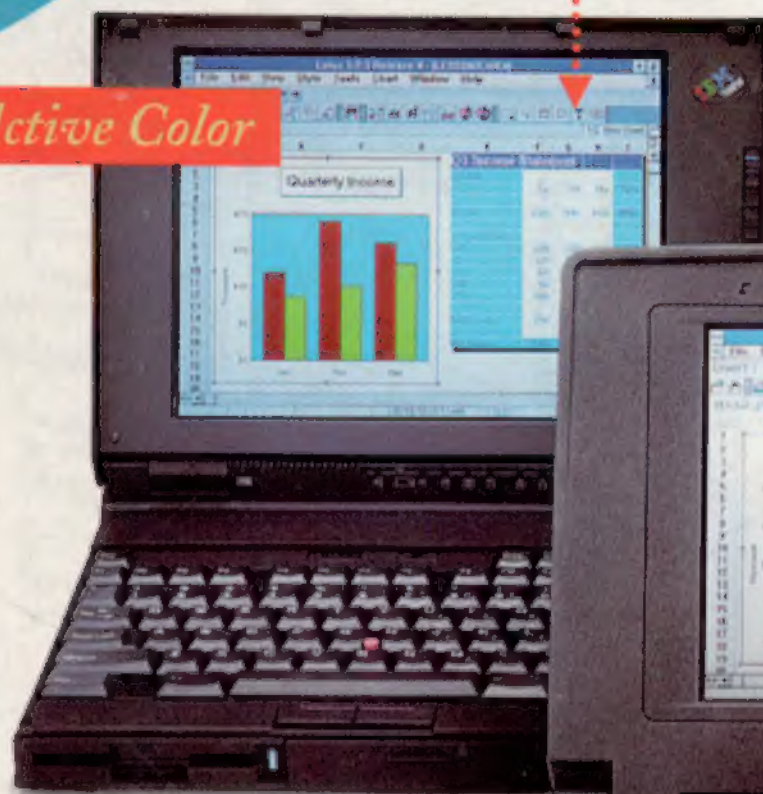
SPECIAL PORTABLE COMPUTING ISSUE

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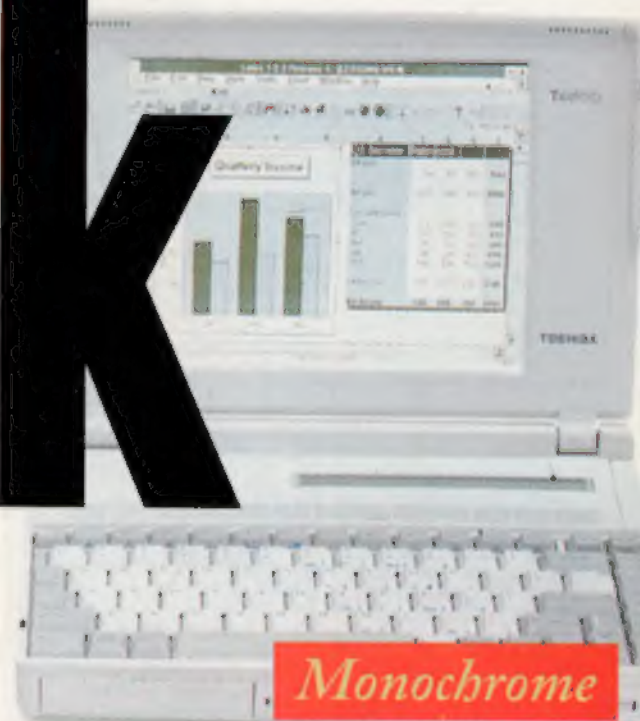
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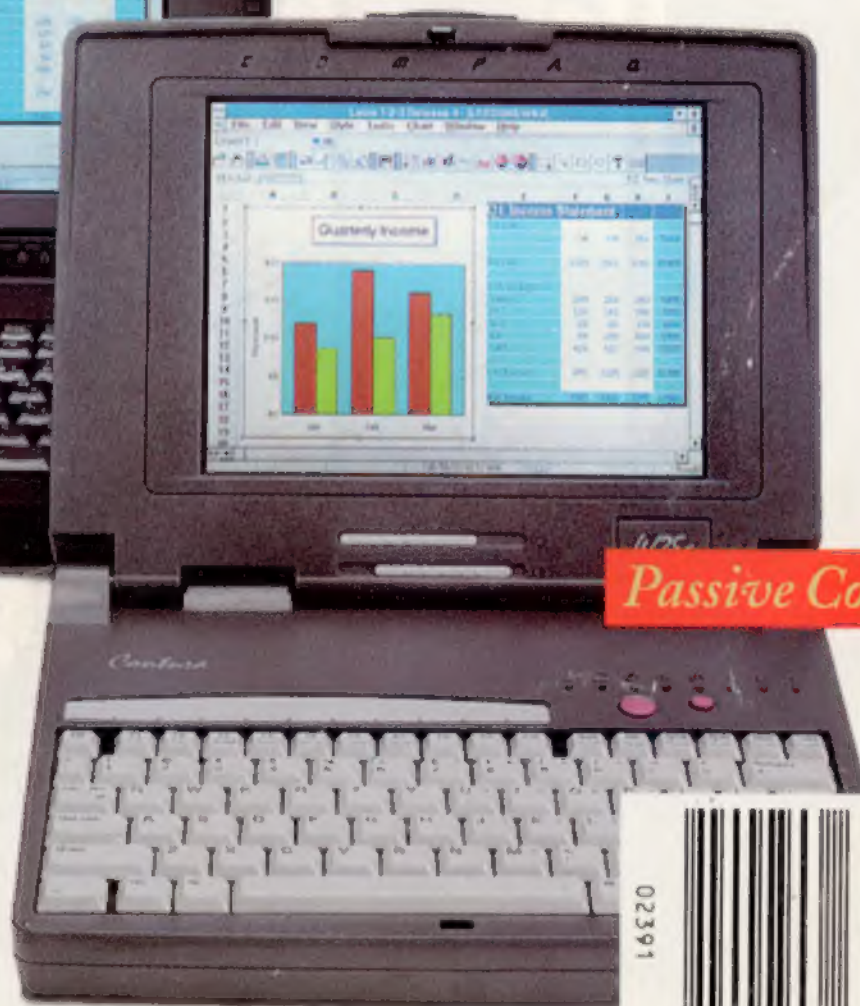
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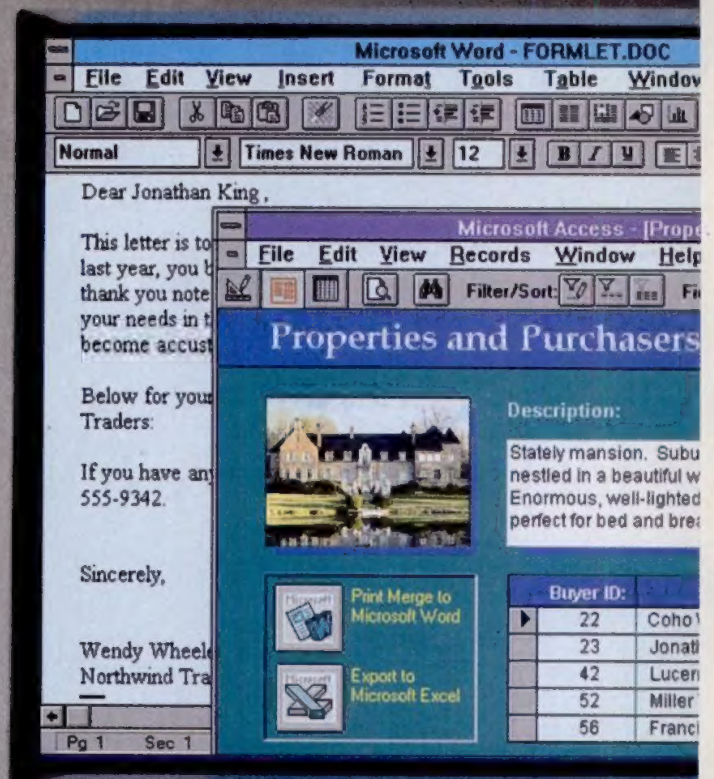
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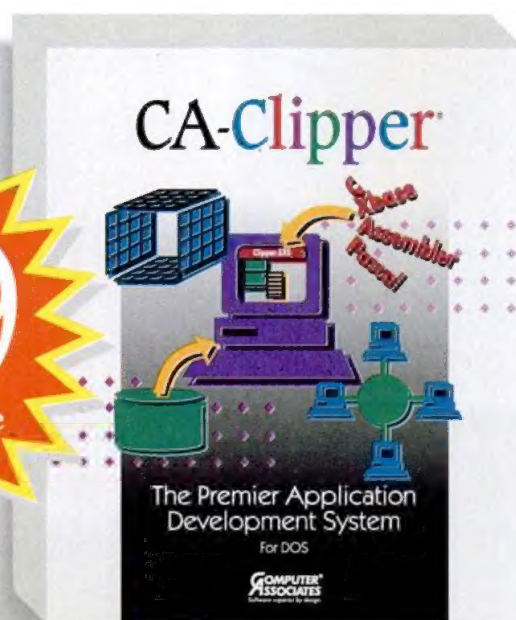
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Predefined Object Classes	YES	NO	NO
Variables Modifiable in Debugger	YES	NO	NO
Customizable Reactive Error Handling	YES	NO	NO
Reads and Writes FoxPro (.CDX) Files	YES	YES	NO
Reads and Writes dBASE IV (.MDX) Files	YES	NO	YES
Reads and Writes Paradox (.DB/.PX) Files	YES	NO	NO

Comparison based on FoxPro Version 2.5 for DOS and dBASE IV Version 1.5.

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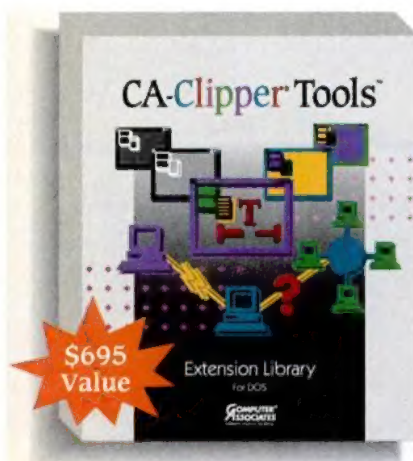
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Inside

W

hat laptop should I buy?" If your friends are anything like mine, this question is as inevitable as death and taxes when people find out you know something about computers.

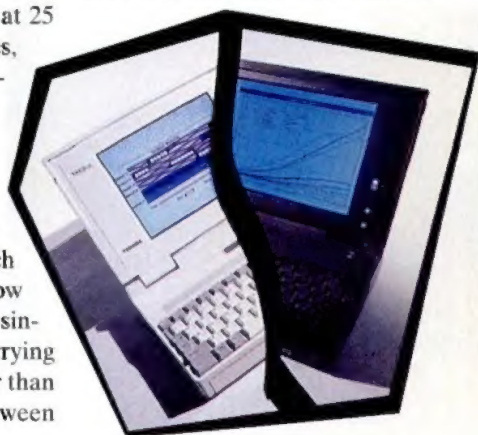
For the second year in a row, we have focused our August issue on portable computing, a topic of such broad appeal that we are willing to devote an entire issue to its intricacies. Transportable computing has not only become inevitable, but also desirable—and in some cases, even preferable.

In a little more than a decade, we've gone from luggables and transportables weighing in at 25 pounds—without AC lines, as useful as boat anchors—to 486 color notebooks under 7 pounds that will run several hours on battery power. The gap between transportability and performance has narrowed so much that computer buyers can now seriously consider owning a single machine without worrying that one arm will get longer than the other on the safari between home and office.

Special issues call for far more teamwork and coordination than the already demanding requirements of a magazine of this size and complexity. Our editors and Labs experts worked hard to put together what we hope is a coherent whole.

The cover story in this issue, "The Portable Puzzle," was produced by our PCs team. Our re-

view of portable printers was managed by our hardware team. The article on contact managers, done with an eye to helping you track all those visits you make as you lug your laptop around, is the work of our software team. Our last feature in this issue comes from our networking/communications group and looks slightly forward. The article on wireless



communications tackles the dream of many notebook computer users: sending and receiving messages, tapping a database in the home office, or accessing an on-line service without the umbilical cord of a telephone line. At least the next time you get hit with *the question*, you can give your friends a copy of this issue.—Joel Dreyfuss

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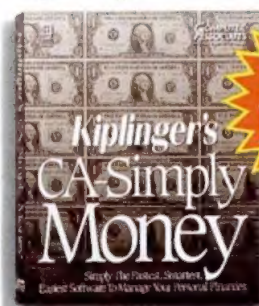
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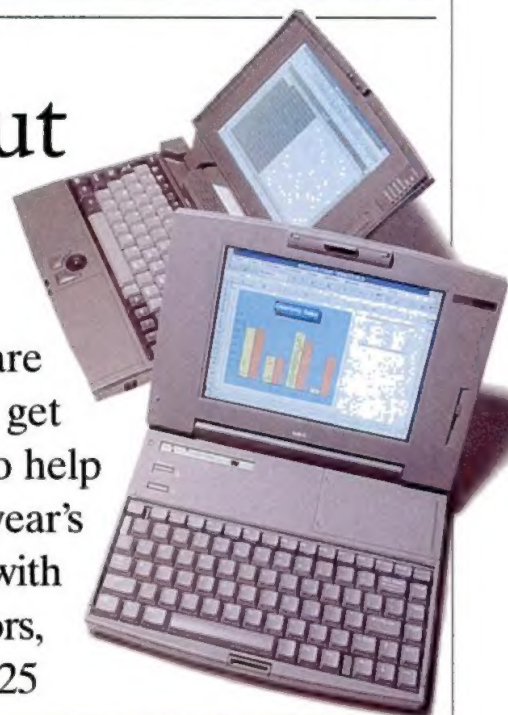
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Portable Computing

Power Without
The Pounds

BY BILL HOWARD

Today's notebook computers are packed with more features and get better battery life than ever. To help you find the right package, this year's roundup examines 68 machines with high-end processors, crisper colors, and PCMCIA.....125



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Untether yourself from phone lines and network cables with wireless communications (page 350).



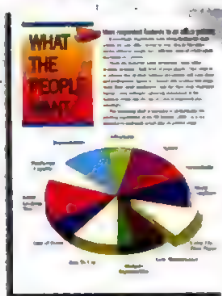
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PC Magazine Reviews

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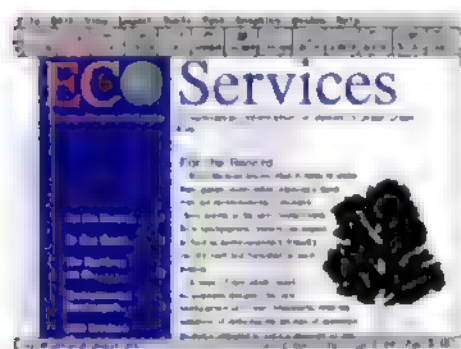
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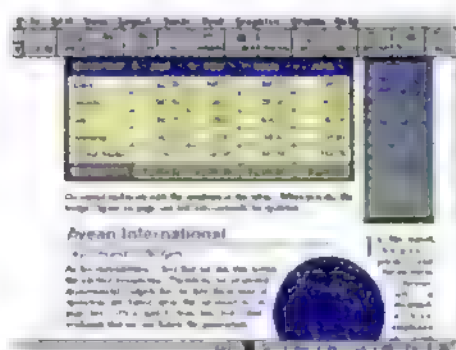
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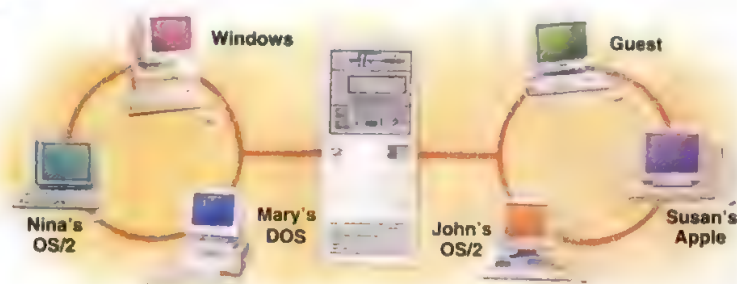
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Protection From Things You Can't Even See.

In Mr. Magoo's case, what he can't see covers lots of territory. For the rest of us, it includes things like invisible electronic emissions.

The more electronic equipment you work with, the greater the concern. That's why some monitor manufacturers offer models with VLMF (Very Low Magnetic Field) features. And charge extra for them.

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It's a difference even Magoo can appreciate. Take our new flat-screen 15" color monitor (SC-528DXL), for example. Together with a fine-grained 0.28 dot pitch and 1,024 x 768 high resolution, it gives you a picture that is not only steady, but crisp and clean.

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Letters

THE NEW PCs

You covered something of major interest in your discussion of Apple's PowerPC-based Mac ("The New PCs," June 15, 1993). There are endless articles comparing Windows NT and OS/2, and every magazine has compared the various CISC/RISC chips themselves, but the PowerPC chip and the operating system that Apple intends to run on it have gone virtually unmentioned in PC publications. Apple and IBM have a large installed base between them, and the new OS will have a lot to do with whether those doors stay open. The entire issue—and the piece on the PowerPC in particular—separates *PC Magazine* from the pack.

Brian B. Mulholland
Port Jefferson Station, New York

There you go again: your second issue comparing the PC platform with others ("The New PCs"), and your second glaring omission of the Amiga line. One can't help but wonder what your criteria for inclusion are. I wouldn't be surprised if there are more Amigas out there than \$30,000 Silicon Graphics machines. The Amiga 4000 uses the same Motorola 68040 CPU that the Macintosh Quadra Systems do. AmigaDOS/WorkBench allows such features as multitasking and interprocess communication, and in far less memory. After using my Amiga 3000, I find Windows 3.1 sluggish and clumsy, even on a VL-Bus-based 50-MHz 486DX2.

George D. Madison
Glendale, California

WHAT'S A PC?

Your June 15 cover story, "The New PCs," raises an interesting question for you and your readers. What is a PC, and what will the PC in *PC Magazine* include? Until this year, I've never questioned your decision to omit workstation computers and operating systems from your definition of a PC, but with RISC-based computers like the Digital Alpha AXP PC on the desktop horizon and alternate operating systems gaining rele-

vance, the landscape is changing.

I urge you to stretch the PC in *PC Magazine* enough to keep mainstream readers informed of the hardware and software that we might find landing on our desks, or in our laps. And have fun defining *mainstream*.

Dean J. Earlix
Auburn, Alabama

THIS ONE'S A KEEPER

Wow! Thanks for the great June 15 issue! John C. Dvorak's Inside Track was a long-overdue commentary on the way Microsoft does business; that is, if it's good for Microsoft, then it's good for the computer user. The previews of 32-bit operating systems were fair and accurate. The slow performance of Windows NT was finally spelled out in detail, and you were the first to admit in print that NT would not be for everyone, not even in the distant future. As for OS/2, you've truly outdone everyone in pointing out its value. And though my experience with Unix is limited, I appreciated the well-done reviews of different Unix alternatives. I plan to keep this issue handy in case I decide to try one of these systems.

Joseph Kelch
Belcamp, Maryland



*"What is a PC, and
what will the PC in
PC Magazine include?"*

GO TELL IT ON THE MOUNTAIN

In your June 15 issue you reported that Windows NT was not for the home user ("Windows NT: The Power Under the Hood"). Of course not! No home user wants to give up 70MB for an operating system! So why aren't you singing the praises of IBM for its success? OS/2 is exactly what we—and you—have been waiting for. Not only did IBM give us the first DOS-compatible, 32-bit, multitasking operating system to run its own 32-bit programs, but OS/2 also runs Windows. That's no small feat! Don't just whisper, "Pssst, hey you, OS/2 works." Shout it from the mountaintop. It's worth more than a couple of pages.

We could all wait for Microsoft to put Windows into a 32-bit operating system that would fit on our desktops, and then wait for the developers to get the bugs out, or we can get OS/2 2.1 today.

Jeffery D. Spencer
Cleveland, Ohio

BASHING THE GREEN-BASHERS

I read with dismay the letter from James F. Glass in the June 15 Letters section. To suggest that computers would have no place in a future blessed with environmental consciousness is simply ridiculous. In the years to come, computers will play an increasingly large role in assisting our efforts to manufacture products, including computers, in an environmentally safe and economic manner. Making computers "green" is part of this effort and should be encouraged. Any additional cost to the end user must be considered insignificant when compared to the alternative cost of an unlivable planet.

Martin A. Killiner
Sugarland, Texas

I was disappointed to read Mr. Glass's letter, in which he lashes out at responsible approaches to environmental conservation. This is one of the worst cases of conspiracy-theory paranoia that I have ever heard of.

Personally I find the news of computers that will cost me less to run, save on air-conditioning expenses, and last

You can take any notebook on a plane. With ours, you can fly it.

Airlines allow you two carry-on items; make one an AST PowerExec™ notebook. The 4/25SL, for instance, actually gives you enough power to autopilot a jumbo jet. But you may prefer to use it, instead, for up to 6½ hours of non-stop computing, the longest battery life *PC Magazine* has seen from any 486-based portable*. When you land, use the two PCMCIA slots to send or fax information anywhere. And while the 4/25SL delivers the best performance in every category *PC Magazine* tests for, there are five other PowerExec models, starting at under \$1,300.** For more information, call 800-876-4AST. For flight reservations, call your travel agent.



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LETTERS

longer to be of genuine interest. As for *PC Magazine* eventually losing its audience, as Mr. Glass asserts, I am certainly going to continue my patronage. My work as an environmental scientist is frequently augmented by your insightful and informative articles and columns.

Paul R. Ames
Bellport, New York

• *PC Magazine* received many letters on the topic of "green" PCs, and while the response was overwhelmingly in favor of these computers, there were several, like Mr. Glass's, that took issue with the environmental movement.—Ed.

WHO'S CALLING WHOM A DUMMY?

I have to take exception to John C. Dvorak's column of May 25, 1993, "The 'Dummy' Phenomenon." He's amazed that there are still beginners among us, and he wonders what rock they've come out from under. He's also pretty sure that when the recent crop of "dummy" books vanishes, there will be nothing out there for newcomers, so we'd all better be computer-literate before the last chance is lost. I think not.

There will always be beginners in the world of PCs. Even though computers are abundant in the workplace, the employees who use them often don't need to know more than how to run the installed software. But at home there is no MIS department to turn to for answers; therefore there will always be a need for beginner books that explain enough jargon for new users to read and understand their manuals and to troubleshoot when necessary.

Donna Currie
Chicago, Illinois

In his May 25 column, Dvorak hits some solid points. Here at the University of Virginia, many students will be expected to buy their own computers beginning next year. We've wired the dorms for networks, and the bookstore is set to offer special package deals on PCs. So what's missing from this picture? A course in Personal Computers 101. We make fu-

ture writers study chemistry and make future chemists study English literature, but we don't teach our students the most necessary occupational and cultural skill: how to use a PC.

The fact is, our institutions can't handle an issue that is scarcely a decade old. Greek mythology is better supported than personal computers.

Will Martin
Afton, Virginia

SAME MONITOR, DIFFERENT IMAGE?

I enjoyed your cover story, "The Green Machine," in the May 25 issue, but I found your comments regarding the

*We make future writers
study chemistry and
make future chemists
study English literature,
but we don't teach
our students how
to use a PC.*

MAG MX17F confusing. You stated that the MX17F "was rated well-below-average in image clarity and sharpness." Is this the same monitor that was the Editors' Choice in the issue of June 30, 1992? That issue described the MX17F's image as being "sharp enough to slice a steak." Did your testing methods differ, or has the monitor changed?

Ken Prosser
Ventura, California

• The testing methodology for this round-up of monitors was different and more subjective than our normal benchmark tests for monitors. Our criteria were based solely on ergonomics. The makers of the MAG MX17F also changed suppliers of their cathode ray tubes in the time between the two issues, so the monitor itself was actually different. To get a comprehensive look at how the MAG MX17F stacks up against its peers today, check out our review of 17-inch monitors next month.—Ed.

CHECK OUT THIS CHECKER

I was disappointed that your review of writing tools, "New Writers' Tools: Better Writing Through Electricity" (May 25, 1993), failed to include the newest grammar checker on the market: PC-Proof, from Intellect Systems. It is available for both DOS and Windows and is being introduced as shareware by many shareware vendors and computer clubs. PC-Proof tries to solve the problem of overflagging grammatical errors by concentrating on only the most serious errors. Flagging too many insignificant style errors creates an "irritation factor."

Franklin Hu
President, Intellect Systems
Renton, Washington

CORRECTIONS AND AMPLIFICATIONS

In our First Looks piece on Pentium-based systems (June 15, 1993, page 38), a photo of an Acer unit appeared incorrectly instead of a photo of the ALR ProVEISA. In the Summary of Features for the same story, the price range of the ALR ProVEISA should be \$6,600 to \$7,000.

In the June 15 New & Improved section, we incorrectly stated that the Dell 325SLi is driven by a 25-MHz 486SL processor. It is actually driven by a 25-MHz 386SL processor.

In the May 25, 1993, cover story, "The Green Machine," our section on monitors incorrectly mentioned the ViewSonic 17 monitor. In fact, we tested the ViewSonic 7 monitor and the results of that test are what appeared in the story.

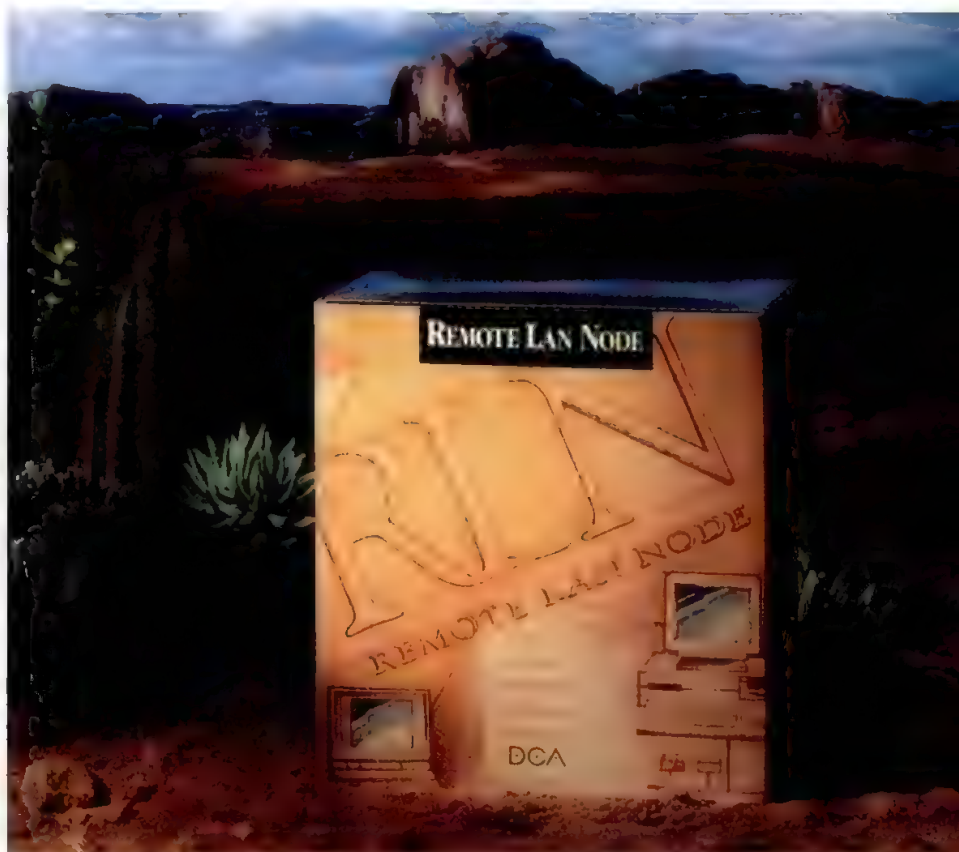
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WHEN REMOTE ACCESS PRODUCTS WERE TESTED IN THE ARIZONA DESERT, GUESS WHO HAD THE HOTTEST SOLUTION?

The test was part of a comprehensive analysis of remote network access solutions done by ZD Labs. They packed up nine dial-in server products and sent a technician out to do some real field testing—in the town of Sedona, Arizona, pop. 7940.

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The report went on to say, "Our winner, DCA's RLN, stood out for its capability to handle multiple communications protocols," commenting that "it won hands-down on flexibility, allowing our remote users to connect to both IPX and IP servers in the same call."

All in all, the report concluded, if you're looking for versatility, "None of the other units we tested came close."



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March 1993

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PC Magazine
February 9, 1993

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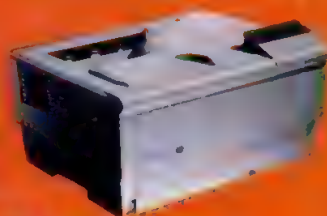
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PCWORLD

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PC Week - May 10, 1993



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CIRCLE 344 ON READER SERVICE CARD

Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Beware Cheap Pentiums

Low prices may mean design shortcuts.

Not all Pentium systems will be created equal, cautions Intel. Concerned that the Pentium's reputation will be marred by machines that have not been optimized for the new processor, the chip maker is taking pains to educate consumers about the finer points of sys-

tem architecture.

Designing a PC that takes advantage of all of the Pentium's potential is no easy feat. And it's not cheap, either. Some manufacturers will take shortcuts, which may account for the low price tags you'll be seeing on some of the Pentium machines. A high-performance cache alone can add up to \$200 to the price of a desktop system, \$500 to that of a server, says Ronald E. Curry, an Intel group marketing manager.

To make sure you're getting a fully optimized system, Curry identifies some key features. Unfortunately, they aren't for the technically faint of heart. Look for a high-performance memory subsystem: It should have a 64-bit data path, 60- or 66-MHz memory bus speed, pipelining and bursting support, and it should take advantage of the Pentium's write-back mode. A Level 2 cache is important—a good one can provide a performance gain of 10 to 25 percent or more. Make sure it's a *write-back* cache (don't be fooled by a *write-thru* cache with write buffers). And look for a local bus



(Intel naturally recommends its own PCI, but a VL-Bus or proprietary local bus is better than nothing). With all of these optimizations, your system will probably cost you in the neighborhood of \$5,000.

If all this sounds over your head and out of your budget, you'll be happy to hear that Intel is not the only CPU manufacturer concerned about quality control. Going

one step further, Cyrix is testing machines based on its Cx486S family of microprocessors to ensure that they're delivering optimal application performance.

Cyrix's involvement in quality control is especially important because many of its customers are no-frills, low-cost PC makers that don't have the research and development resources, nor the design expertise, of Intel's mainstay customers—the Compaqs and Dells. For Cyrix's stamp of approval, look for PCs with the red Peak Performer logo. They certainly won't be the screamers that well-designed Pentium systems will be, but at least they'll run as fast as they can.

—Mary Kathleen Flynn

Meaningful Ink

PEN COMPUTING WON'T REALLY take off until handwriting-recognition technology gets substantially better. In the meantime, pen makers are renewing their efforts to push ink as a data type. A new data format that stores pen-centric information and is endorsed by all the significant players in the pen market strengthens the case for unrecognized ink.

The new electronic ink specification is the brainchild of Dan Bricklin, who co-invented VisiCalc and is now the vice president of new technology at pen software developer Slate Corp. The name of the spec is Jot, which, quips Bricklin, stands for "joy of technology." He believes Jot will be to the pen industry what the TIFF format is to the graphics community.

Jot has captured broad support: Apple, General Magic, GO Corp., Lotus, Microsoft, and Slate made a joint announcement of Jot 1.0 at Spring Comdex. Jot will make it into the next major release of Windows (code-named Chicago and due next year), says Pradeep Singh, group manager of the mobile services group at Microsoft.

Independent of operating systems and hardware platforms, the Jot 1.0 format "defines more than a bitmap," says Bricklin. It describes attributes of pen-created data such as the amount of pressure applied to the pen, the order of strokes, the intervals between strokes, the pen tip used, the angle of writing, sampling rate of the digitizer (for synchronizing with voice, for example), and color (different colors for different people responding to a memo). Not all applications will support all properties, and Jot will let apps ignore what they don't understand. By supporting Jot, nonpen systems will also be able to access pen-created files. Over time, Jot will support new properties as they are developed.

Many PC users will still hold out for better handwriting recognition engines—Microsoft's Singh says cursive recognition will get much better over the next year or two—but for such applications as note taking and signature verification, Jot does a lot to make ink more meaningful.

—Mary Kathleen Flynn

Pipeline By Robin Raskin

The Microsoft Machine

Charlie Chaplin's *Modern Times* will look tame in comparison to the office equipment revolution we're about to witness. The banes of our office existence—fax machines, printers, telephones, copiers, and computers—are beginning to unite. And they just might do it under the Microsoft banner.

In the latest and perhaps most far-reaching aspect of what's only half-jokingly referred to as Microsoft's "total world domination" strategy, we meet Microsoft At Work—an operating system architecture that could spawn a plethora of new hybrid products. A Microsoft At Work telephone might have an LCD that walks you through the agony of a conference call setup, or lets you "view" a summary before you listen to a gaggle of phone messages. With At Work, faxing goes digital (perhaps we'll call it "daxing"). You could saunter up to your fax machine, pop a disk in, and broadcast a document to a whole group of people by using a simple touch-screen interface. In an At Work world, copiers notify you when their toner is low, printers tell you when they're out of paper, and editable digital information is the preferred deliverable.



All of these new office machines will work standalone. All are backward-compatible with existing office machinery. But in the optimal situation, when your PC is used to communicate with the brood, you are in total control of all your office equipment, at least theoretically. A smorgasbord of vendors including Delrina, Hewlett-Packard, Ricoh, McCaw Cellular, US West, and Yamaha, will be among the first to license the At Work architecture for their office products.

Microsoft's technology is based on a tiny, real-time multitasking OS. Other pieces include security for handling encryption and signature authentication, rendering technology for screen drawing and document viewing, and a special set of GUI services created with office machines in mind. Rather than inventing yet another standard, Microsoft is using its well-established Windows messaging APIs as the backbone for At Work communications.

Last December, Microsoft announced Modular Windows, its "couch potato" operating system—the brains behind a new generation of interactive TV products. In May the software giant, along with Intel, entered the telephony fray with an API that lets Windows work closely with the telephone network. If any one of these new Microsoft-based machines hits pay dirt, Microsoft strikes it richer than ever. If all three work out, the contest may be over.

Robin Raskin is an executive editor of PC Magazine.

The machine does not isolate man from the great problems of nature but plunges him more deeply into them.

—ANTOINE DE SAINT-EXUPÉRY
(1900-1944)

Ports of ACCESS

EVEN THE MOST INTRACTABLE DOS champion casts an occasional longing glance at the Apple Desktop Bus, which lets Mac users quickly daisy-chain multiple input devices to their machines. But an emerging desktop bus specification, ACCESS.bus, may shortly end the longing. Developed by Digital Equipment Corp. and Philips

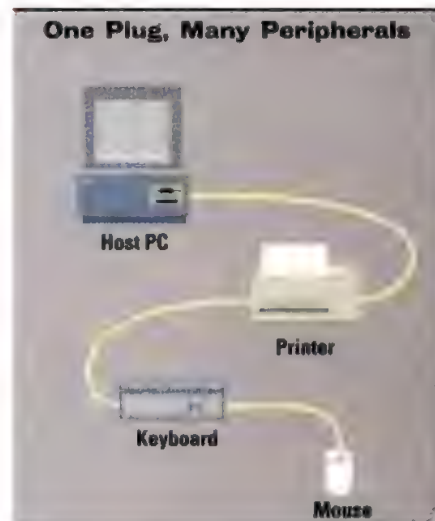
Semiconductors, but now controlled by the independent ACCESS.bus Industry Group (ABIG), it shows promise of becoming a PC-industry standard.

ACCESS.bus attempts to take the pain out of setting up relatively low-speed serial I/O devices—mice, modems, and printers, for example. As many as 125 can link in a daisy chain over a total distance of 8 meters. All use the same type of cable: a shielded, four-wire design featuring modular, phone-style connectors on each end.

ACCESS.bus exhibits impressive dexterity, which springs from a master/slave communications arrangement between the host—an ACCESS.bus controller inside the computer—and intelligent peripherals, each of which automatically receives a unique address upon connection. This eliminates the need to diddle with switches or jumpers and set baud rates. Attached devices can be *hot-plugged* (meaning that they popped in or out while the bus is running). Multiple peripherals of the same type can share the bus, a feature that is presently of limited value (11 trackballs would, for instance, all move the same pointer) but one that opens the door for applications in which each device can control (or be controlled by) its own process.

If it gains acceptance, ACCESS.bus might spur development of what Kevin Gardner, a marketing manager for Philips Semiconductors, calls "personal peripherals"—I/O devices that users would carry and simply plug into the nearest available machine. Gardner sees especially strong benefits for individuals who are coping with disabilities.

Currently, only Digital manufactures any systems that include an ACCESS.bus desktop bus—and those are workstations. Still, ABIG counts a few industry heavyweights among its 29 voting members (Microsoft, for one), and some already have products. Honeywell produces a keyboard, Logitech makes mice, and a new firm, Computer Access Technology, builds an ACCESS.bus card for AT-compatible PCs. If successful, ACCESS.bus could transform hardware ports from scarce resources into commodities.—Gary Berline



Like the Apple Desktop Bus on the Macintosh, the ACCESS.bus will let users quickly daisy-chain multiple input devices to their PCs.

Yet Another Bus Route

DELIVERING TRUE FULL-MOTION video to the desktop may mean adding yet another hardware bus to the PC. The Video Electronic Standards Association (VESA) is developing a specification for a multimedia bus that would make it cheaper—and easier—to integrate motion video and other functions onto graphics adapters. Meanwhile, graphics controller makers are adding motion-video capabilities to their graphics cards and chips.

VESA is currently working on two potential solutions to today's awkward,

expensive motion-video subsystems. One of its subcommittees is proposing an extension of the current VESA connector. Because the current connector is limited to a practical data-transfer rate of 25MB per second, boards attached to it are restricted to producing motion video at 640 by 480 pixels with 256 colors. The Advanced Feature Connector that has been proposed would increase the bandwidth sixfold, to 150MB per second—thereby boosting the resolution up to 1,280 by 1,024 pixels.

The standard should be finalized by summer's end, with products to follow soon after.

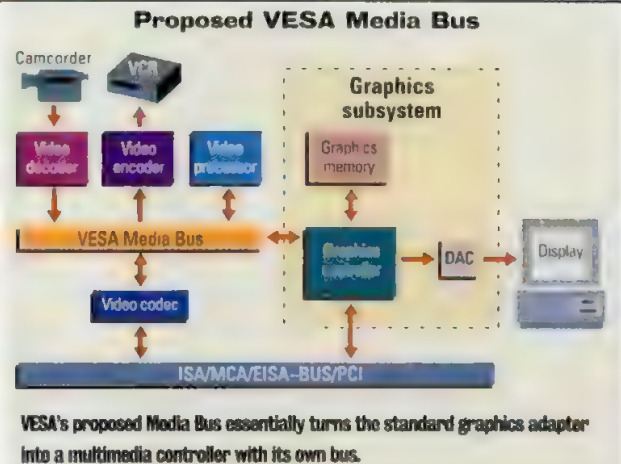
Another VESA subcommittee is working on a multimedia bus specification that should help drive down the cost of multimedia. The spec essentially turns the standard graphics adapter into a multimedia controller with its own bus. Multiple peripherals—graphics controllers, video-capture chips, TV tuners, video-conferencing chip sets, video codecs, and the like—can be attached so that they can all use the graphic adapter's frame-buffer memory, eliminating the need for each board to have its own expensive memory.

To take advantage of the multimedia bus, most graphics controllers will probably have to be redesigned, and some performance issues will have to be resolved. (For example, running multiple concurrent motion-video applications may hamper performance.) However, products should begin to show up next year.

In the meantime, individual companies are working on all-in-one board solutions that may surpass VESA's multimedia bus before it even leaves the garage. Tseng Labs has already coupled its W32 graphics controller with its Viper video image processor. Because the two chips can share the same frame-buffer memory, the cost of adding video is greatly reduced.

And this fall, Oak Technologies will introduce a new GUI controller, called the Spitfire, that handles NTSC video (the U.S. broadcast standard) as well as graphics acceleration. It will let you display a live video window without any additional chips or expansion boards.

Other approaches to integrating motion video—capturing as well as displaying—are due shortly.—*John R. Quain*



Top Retail Software

Current ranking	Last issue	Product, company
1	1	MS-DOS 6.0 Upgrade Kit Microsoft Corp.
2	2	Microsoft Windows 3.1 Microsoft Corp.
3	3	QEMM-386 6.0 Quarterdeck Office Systems
4	—	WordPerfect 5.2 for Windows WordPerfect Corp.
5	—	Lotus Improv for Windows Lotus Development Corp.
6	10	Microsoft Office for Windows 3.0 Microsoft Corp.
7	12	WordPerfect 5.1 WordPerfect Corp.
8	7	Quicken 2.0 for Windows Intuit
9	8	LapLink V Traveling Software
10	—	The Norton Utilities 7.0 Symantec Corp.
11	11	Excel for Windows 4.0 Upgrade Kit Microsoft Corp.
12	9	Quicken 6.0 Intuit
13	14	Paradox for Windows 1.0 Borland International
14	—	Excel for Windows 4.0 Microsoft Corp.
15	—	Office for Windows 3.0 Upgrade Kit Microsoft Corp.

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending June 5, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

V.How Fast?

TODAY, YOU CAN BUY ALMOST any modem and be reasonably confident that it will work with just about any other modem that supports the same speed. But the days of easy interoperability will soon be over—at least for a while.

As the CCITT standards body duking it out over the speed of the next generation of modems (known as V.fast), the two largest chip manufacturers have forged ahead without a common standard. By the end of the year AT&T and Rockwell will offer modems that outrun anything currently available. But even though they may offer the same high speeds, they connect to each other at those speeds. Modem manufacturers will have to choose sides carefully.

AT&T's chip set is a major force in the high-speed modem market. During the next year the company plans to introduce a V.turbo modem capable of speeds up to 19.2 Kbps. Rockwell holds 75 percent of the present market. It will introduce a "V.fast" modem that, despite its name, will not comply with the specification expected from the CCITT. This modem will also offer 19.2-Kbps speed; a 24-Kbps modem is expected from Rockwell by year-end. At the same time, other vendors, such as US Robotics and UDS Motorola, are expected to offer nonstandard 19.2 schemes.

But introducing incompatible chip sets only confuses a system that had been working well until now. Modem manufacturers can only hope that the chip-set vendors come to their senses; as Megahertz CEO Spencer Kirk states, "Requiring that customers fall back to 14.4 Kbps because of a political inability to reach agreement on what has to be done is ridiculous."—*Angela Gunn*

Electronic Pubs Cross Platforms

IN ORDER FOR ELECTRONIC PUBLISHING to be successful, on-screen documents need to be indistinguishable from their print brethren—with full support for font, style, graphics, and color. Different companies are blazing various paths to this electronic ideal. To date, Adobe's cross-platform performer, Acrobat, has created the biggest stir. No Hand Software's Common Ground, available on the Macintosh, comes on strong with an alternative approach. Late to the race, the newly announced Replica, from Farallon, could prove a winner.

Like the others, Replica has two components—a Creator and a Viewer. The Creator kicks in when you print a file from any Windows or Mac application. The "Replica-ed" file can be distributed to other machines using any MAPI or VIM message transport, or can be saved to disk and transported. The Replica Viewer can travel along with the document and extract it. The document gets displayed on the screen with formatting completely intact. Content can be searched as well as cut and pasted from the Windows Clipboard. Unlike Acrobat, Replica cannot annotate content.

The Farallon solution has an elegant simplicity because of its direct ties to both Windows and System 7. The Replica file format includes Windows' Graphics Device Interface (GDI), embedded TrueType fonts, and Mac's QuickDraw information in a highly compressed format. In contrast, Adobe's Acrobat relies on an intermediate step that converts these elements into Adobe's Portable Document Format (PDF)—a page description language based on Display PostScript.

In a two-step process, Acrobat Exchange creates .PDF files; the Acrobat Reader lets users annotate, view, navigate, and print them. Acrobat extends its turf by supporting the Standard Generalized Markup Language (SGML). It also uses JPEG compression, which is best suited for full true-color

THE ENVIRONMENTAL PROTECTION AGENCY'S

Energy Star program is off to a powerful start. Moments after breaking a tie in the Senate, Vice President Al Gore personally unveiled the first computers, monitors, and printers to follow the EPA's energy-conservation guidelines. The unveiling took place next door to the White House in an auditorium at the Old Executive Office Building, where even the bathrooms have recycling bins for cans and newspapers. What's next for Energy Star? Globalization, says Brian Johnson, the program's manager.

GROUP DECISION MAKING IS INEVITABLY

slow—which is one reason it takes so long to develop PC standards. But the Institute of Electrical and Electronics Engineers, a leading standards sponsor, is working hard to speed up the standardization process, says IEEE president Martha Sloan. One

images. Its use of the Verity search engine, SGML, and JPEG makes Acrobat an attractive and powerful solution for professional publishers.

No Hands Software's Common Ground takes a different approach. Rather than shipping scalable fonts in the portable document, it rasterizes them first and transports a bitmapped image. The driver creates

a file containing bitmapped representations of Type 1 and TrueType fonts in four resolutions: 72 dpi for Mac screens, 100 dpi for Windows screens, 200 dpi for fax transmission, and 300 dpi for laser printing.

With both Acrobat and Common Ground priced below \$200, Farallon

hopes to beat them out with pricing under \$150. Replica won't handle editing and annotation or large JPEG images. It only embeds TrueType fonts. But unlike Acrobat, its viewer can be distributed freely. Each of these products represents a new stake on the electronic publishing frontier, but there's bound to be a shootout.

—Robin Raskin

Briefs

tactic being explored is to distribute more information electronically—possibly even the standards themselves.

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can list it with the on-line Stolen Computer Registry free of charge. To receive a free demo of the registry via modem, dial 212-505-7526, or call 212-777-1291.

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bombing, Rent-A-PC has launched PC-Pool, a service that guarantees temporary replacement equipment 24 hours a day, 7 days a week. A subscription reserves equipment that is held in a bonded inventory at multiple locations along the east coast. For more information on the service, call 212-206-0660 in New York City, 617-320-0072 in Boston, or 703-533-0855 in Washington, D.C.

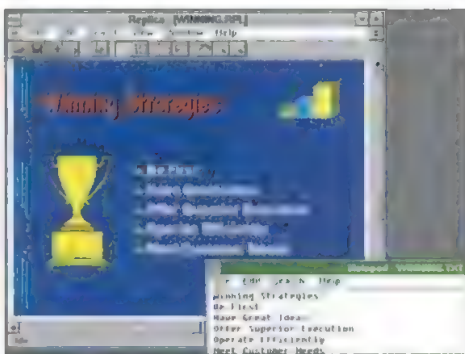
—Mary Kathleen Flynn

Numerology?

TWO USUALLY COMES AFTER ONE, but upgrading software may mean jumping from Version 1.0 to Version 6.0. We call it Version Crazy, Version 2.0.

All the major software firms are jumping into the act. To give Windows software more seniority, vendors are skipping version numbers to link a new Windows release to a DOS release that has a long history and a high version number. Take Lotus, for example. If you plan to upgrade from Lotus 1-2-3 for Windows, Release 1.0, you'll be moving to Release 4.0. Lotus skipped Releases 2.0 and 3.0 to keep parity with its DOS versions. Borland's Quattro Pro for Windows is making an even bigger jump—from Version 1.0 to Version 5.0. WordPerfect named the first release of its Windows edition WordPerfect for Windows 5.1 by simply skipping Versions 1.0 to 5.0. Not to be outdone, Microsoft is naming the next release of Word for Windows (the one after 2.0) 6.0, making all three Word programs (DOS, Windows, and Macintosh) the same number.

dBASE started the version confusion when it initially released as dBASE 2.0. There never was a Version 1.0, because Ashton-Tate felt 2.0 conveyed market and user experience. Of course, now it's up to dBASE IV, Version 2.0.—Christopher Barr



Farallon's Replica is the latest product to let you view documents on different platforms.

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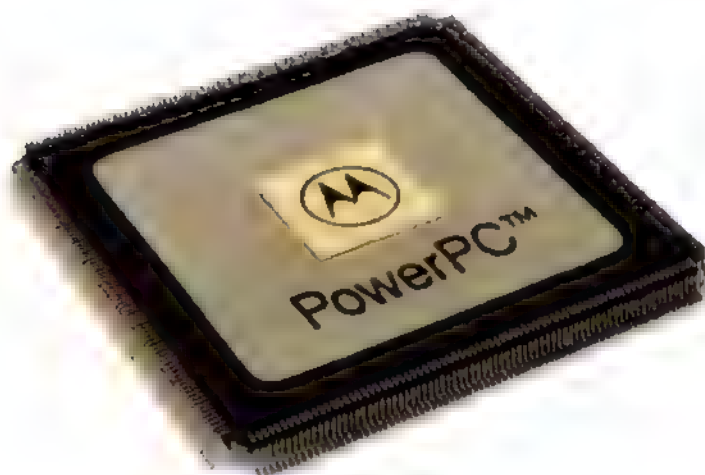
	Intel Pentium	PowerPC 601
Frequency (MHz)	66	66
SPECint92	64.5	>60
SPECfp92	56.9	>80
Power (watts case)	20W	23W
Die Size (mm ²)	262	120

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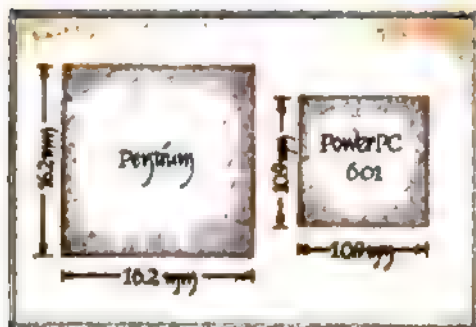
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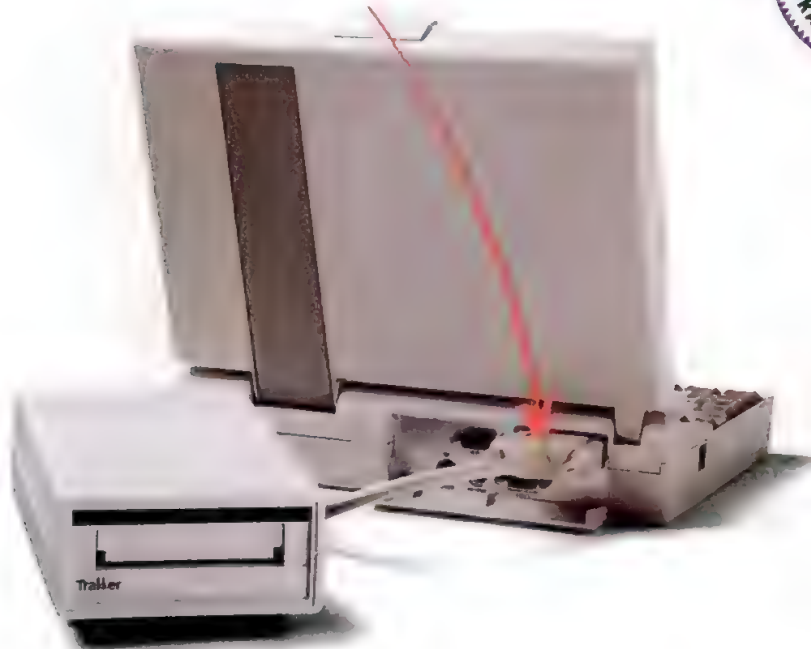


Motorola's announced simulation performance of the 66MHz version of the MPC601. Thermal comparison is based upon preliminary Intel specification for the 66MHz Pentium, and the performance of samples of the 66MHz version of the MPC601.

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

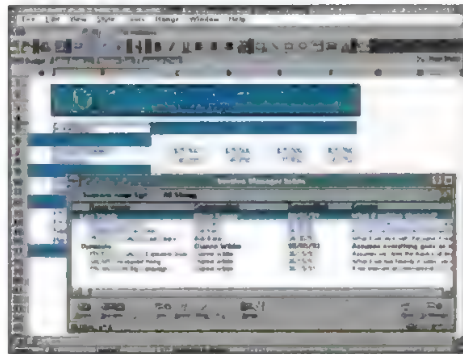
■ Lotus Answers Spreadsheet Competition

1-2-3, Release 4: Improvements, Innovations

BY CRAIG STINSON

With its reputation for spreadsheet technology on the line, Lotus Development Corp. has delivered. 1-2-3, Release 4 for Windows bears scant resemblance to its troubled predecessor. The company has reworked 1-2-3/W from head to toe, produced a spreadsheet that is completely at home in the graphical environment, incorporated the established innovations of its competitors, and contributed some bold new ideas.

Topping the innovation list is Release 4's Version Manager, the public introduction of the "Chronicle" technology that Lotus has been sneak-previewing. Version Manager allows you to create named sets of alternative values, with or without formulas and formatting instructions, for worksheet ranges. These "ver-



VERSION MANAGER: Track different scenarios.

sions"—you can have as many as you like for as many ranges as you like—are flagged by date, time, and creator, and can be

accompanied by comments of any length.

A simple stay-on-top window controls the feature, letting you create new versions, swap existing versions in and out of ranges (a powerful new form of what-if analysis), display a version index (sorted by creator, name, or creation date), and generate a summary report on a separate worksheet. Moreover, combinations of versions may be assembled into named "scenarios." For example, you might create one scenario that combines your best-case sales forecast with your worst inflation fears, a second to line up the doomsday picture across the board, and so on. These scenarios, like individual versions, can be swapped in and out of your worksheet with simple mouse clicks and tabulated for later study.

While Version Manager is invaluable for single users, it offers particular benefits for projects requiring input from multiple workers. To that end, Lotus has added features for 1-2-3 users who are also Notes users:

Continues on page 38

■ Newest Notebook PCs

Five Models Focus on Color, Efficiency

In this issue's cover story, PC Labs tests 68 new notebook PCs. The five new notebooks we evaluate here in First Looks—from Acer, CompuAdd, Texas Instruments, Toshiba, and Zeos—highlight the latest in portable technology.

AcerNote 750c

BY BRUCE BROWN

One of the best-priced active-matrix color notebooks around, Acer America Corp.'s \$3,699 486SL/25-based AcerNote 750c is a powerful system.

Equipped with 4MB RAM, a 120MB hard disk, and a standard PCMCIA fax modem, the AcerNote 750c weighs and measures just a bit more than you'll like: It weighs 8.6 pounds, including its 1.4-pound AC adapter, and measures 2.2 by 11.3 by 9 inches (HWD).

The 9.5-inch VGA display, from DTI, has a wide viewing

angle but isn't as bright as some of its competitors; for example, it's noticeably dimmer than the IBM ThinkPad 720C. An external 1,024-by-768 video port sup-



NICE PRICE: The \$3,699 AcerNote 750c uses active-matrix color.

ports simultaneous display.

Other attractive features include the unit's two PCMCIA Type II slots and a comfortable integral trackball. Without the fax modem, the two slots can accommodate a single Type III card. The built-in trackball and wrist rest are placed in front of the keyboard and have wide, responsive buttons.

The AcerNote 750c did well on our benchmark tests. The notebook's 3.8 million Graphics Winmark score is also above average compared with other 486SL/25-based notebooks. A fairly

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Lotus 1-2-3

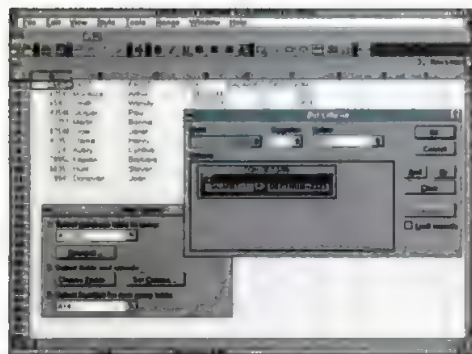
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concurrent file access, automatic notification of changes to a worksheet, flags that direct attention to unread versions, and the ability to grant varying permissions to particular users.

Workgroup users without Notes can still take advantage of the new mail features. The Send Mail command supports Notes, cc:Mail, and other VIM and MAPI-compliant mail systems.

Those who use 1-2-3 as a data manager will appreciate Release 4's second major innovation: a complete replacement for the creaking query-and-extract mechanism that 1-2-3 foisted upon the spreadsheet world in 1983. Old worksheets with criterion and extract ranges still work, of course, but these ranges are no longer required. Instead, you can express criteria by pointing and dragging in a dialog box that's designed to minimize confusing Boolean terminology.

Extracted records land on the worksheet in a nameable query object identified by a frame with handles. You can



QUERY: Eliminate extract ranges.

drag the handles to display more or fewer records or fields, select entire fields by clicking once on the field heading, and manipulate the extract in various other ways. Simple menu commands let you modify the query, refresh the extract, and even assign report-worthy aliases to cryptic field headings.

The new database features

FACT FILE

Lotus 1-2-3, Release 4 for Windows

Lotus Development Corp.,
55 Cambridge Pkwy.,
Cambridge, MA 02142;
800-343-5414, 617-577-8500;
fax, 617-693-3981

List price: \$495 (upgrade price, \$129)
Requires: 4MB RAM, 8MB hard disk space, Microsoft Windows 3.0 or later
In short: 1-2-3, Release 4, is a complete overhaul of Lotus's Windows spreadsheet featuring a superb scenario manager, simplified database management, an expanded function and macro language, and top-to-bottom improvements in the user interface

ON READER SERVICE CARD

work with both internal tables and all external formats supported by DataLens drivers. At release time, those drivers included dBASE, Informix, OS/2 Data Manager, ODBC, Paradox, and SQL Server.

INTERFACE RENOVATION

To assist with worksheet organization, Release 4 offers named pages, which are superficially like those of Quattro Pro for Windows. Page tabs appear along the top of worksheet windows, allowing for easy navigation, and names assigned to pages are automatically used in formula references. Naming the pages requires a mouse, unfortunately, and the Goto command knows nothing of page names. Moreover, there's no way to select a range of pages by clicking on the tabs.

Below the worksheet, Release 4 features a live status bar, just like the ones in other Lotus applications. Above the sheet is a streamlined menu system. The classic slash-key menu is still available, but both character-

mode immigrants and experienced Windows hands will find the new menu tree more sensible and easier to learn. Windows users will also appreciate Release 4's use of the common dialog boxes (enhanced to show file dates and sizes). Gone is the previous 1-2-3/W's insistence on using the same directory over and over, no matter where you did your last save.

Gone, too, are all traces of the worksheet/WYSIWYG schizophrenia that beset Lotus's character-mode spreadsheets. The slotted font system is gone, all data is stored in a single WK4 file, and all activity—modeling, formatting, and charting—takes place in a single integrated environment. Charts live only on the worksheet, drawing tools are available for use directly on the worksheet, and both menus and icon palettes adjust automatically to accommodate whatever's currently selected.

All data entry and editing now takes place in the cell, although there's still an edit bar above the worksheet for familiarity. Two good new ideas on that edit bar, a navigator icon and a function icon, assist with formula building. Clicking these opens a list of all named ranges (available for selection in formula references as well as for navigation) and a list of 1-2-3's functions. The function list is organized by category and includes a customizable menu of the functions you need most often. When you select a function, a description appears in the dialog box. If you need more explanation, a click on the question-mark icon takes you to the relevant help page.

The function library itself is significantly expanded. In addition to specialized engineering and statistical functions, it now includes a number of smart date-

arithmetic functions for extracting information from Version Manager, and a set of "pure" alternatives to the standard aggregation functions. With @PURE-COUNT and @PUREAVG, for example, you no longer need to worry about having return values skewed by nonnumeric inputs. Another welcome change: You can now type criterion arguments directly into the database statistical functions.

For the macro programmer, Release 4 offers a complete set of menu-equivalent macro verbs, a fine dialog editor (shared with its originator, Ami Pro), macro commands for creating standard alert boxes and pick lists as well as custom menus, and the ability to plant command buttons on the worksheet. There is still no debugger.

Some disappointments remain. The range-naming capabilities are still primitive compared to Excel's. Error values returned by formulas are just as uninformative as they were a decade ago. The new drag-and-drop copy and move procedures are great, except that they don't warn of accidental overwrite (this is particularly hazardous given the program's single undo level). 1-2-3 still can't read common database formats directly (as Quattro Pro and Excel can), and its import of .XLS files is limited (for example, no charts and no title settings).

Graphing in Release 4 is more intelligent than in earlier versions but less intelligent than it needs to be. (For example, if you select a single series of data points and a row of date headings and then drag the graph icon, 1-2-3 plots both as data series.)

But relative to its plethora of new virtues, these failings are minor. Release 4 is a superb new spreadsheet program that puts Lotus back at the forefront of spreadsheet design. □



From August 2 through August 6, you can go on-line to download a demo of Lotus 1-2-3, Release 4 for Windows or to discuss the program with Craig Stinson and Lotus product manager Paul Stroube. Type GO ZNT:EXEC from any CompuServe prompt.

Notebooks

CONTINUED FROM PAGE 37

hefty 1.5-pound nickel hydride battery and good power management helped the AcerNote 750c last 5 hours 12 minutes on PC Labs' ZDigit test.

Besides a one-year parts and labor warranty with free on-site service, Acer offers a temporary replacement system within 24 hours after notification and provides international repair service during the warranty period.

The AcerNote 750c's active-matrix color screen, decent trackball, and good performance and battery life (all available in the mid-\$3,000 range) are an attractive value.

• List price: AcerNote 750c with 4MB RAM, 120MB hard disk, PCMCIA fax modem, DOS 6.0, Microsoft Windows 3.1, Microsoft Works for Windows, \$3,699. Acer America Corp., 2641 Orchard Pkwy., San Jose, CA 95134; 800-733-2237, 408-432-6200; fax, 408-432-6221.

Circle 428 on reader service card

CompuAdd 425TX

BY BRUCE BROWN

In notebook computing, power management is the name of the game, whether systems employ Intel's 486SL CPU or other chips that help the system work more efficiently. CompuAdd's 425TX takes the latter approach. This lightweight Intel 486SX/25-based notebook features a PCMCIA type II expansion slot and PicoPower Technology's Evergreen power management chip set.

With 4MB RAM, a 120MB hard disk, and a 9.5-inch monochrome display, the 425TX sells for \$1,895. The 2-by-11.5-by-8.5-inch unit weighs 5.8 pounds with

its nickel cadmium battery installed and has a 7.1-pound traveling weight with its AC adapter. The system's 4MB RAM is expandable only to 8MB, and no larger hard disks are currently available.



EVERGREEN: A PicoPower chip set manages the CompuAdd 425TX's CPU.

The Evergreen power management chip cuts the CPU's power when it's inactive and lets you select among several power time-out and system status features. Though the chip does help the system run more efficiently, it didn't appear to help with battery life in testing. The 425TX ran for 3 hours 46 minutes on the ZDigit Rundown test and only 2 hours 3 minutes on the Battery Rundown test.

A built-in trackball located on the upper-right corner of the keyboard moves smoothly; however, the buttons need deliberate clicking.

The 425TX fared well on our benchmark tests, with an overall DOSmark score roughly equivalent to the average score attained by 25-MHz 486SX-based systems but with particularly high memory operations scores. The CompuAdd's 3.1 megapixel-per-second Graphics Winmark score is also good

compared with other notebooks.

In addition to a one-year parts and two-year labor warranty, CompuAdd offers a 30-day money-back guarantee, 30-day price protection, and toll-free technical support.

• List price: CompuAdd 425TX with 4MB RAM, 120MB hard disk, DOS 6.0, Microsoft Windows 3.1, \$1,895; 4MB RAM upgrade, \$350; internal fax modem, \$119. CompuAdd Computer Corp., 12303 Technology Blvd., Austin, TX 78727; 800-627-1967, 512-250-1489; fax, 512-331-2794.

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TI TravelMate 4000E WinDX2/50

BY TIN ALBANO

The TI TravelMate 4000 won our Editors' Choice ("The Laptop Gap" March 30, 1993) by taking top performance honors on our ZDigit battery test and four out of seven benchmark test



WORKHORSE: Active color and a 486DX2/50 power the TravelMate.

suites. Texas Instruments added an active-matrix color screen to this system, called it the TI TravelMate 4000E WinDX2/50 Active Color, and wound up with one of the most powerful color portables available.

The TravelMate 4000E costs a steep \$4,995 with 4MB of RAM and a 200MB Seagate hard disk. The 8.4-inch TFT active-matrix color display, from

Sharp Electronics, has a wide viewing area that supports 256 colors at a resolution of 640 by 480 pixels, and the unit can simultaneously display at the same color and resolution on an external monitor.

Performance separates the TravelMate 4000E from other color notebooks. With the help of its 50-MHz 486DX2 chip, the TravelMate 4000E's processor and memory turn in scores about double that of the AcerNote 750c while producing above-average numbers on the rest of the benchmark tests. The TravelMate's only drawback was its 3 hour 2 minute ZDigit Rundown time, 2 hours less than the Acer's ZDigit Rundown time.

The TravelMate 4000E's keyboard is spacious and responsive, with a full set of function keys and dedicated cursor keys. Proprietary power-management software powers down the CPU between keystrokes; this helps increase battery life and keep CPU temperature low.

TI's service and support policy includes a one-year limited parts and labor warranty, but on-site service through NCR costs \$129 per year. Users who need heavy processing power and the advantage of an active-matrix color screen will find that the 6.2-pound TravelMate 4000E is worth every penny.

• List price: TI TravelMate 4000E WinDX2/50 Active Color with 4MB of RAM, 200MB hard disk, DOS 6.0, Microsoft Windows 3.1, Microsoft BallPoint Mouse, \$4,995. Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720; 800-527-3500, 817-771-5856; fax, 817-774-6660. Circle 430 on reader service card

Toshiba Satellite T1900C

BY BRUCE BROWN

If you've been waiting for an affordable color notebook with compromises weighted in your favor, the Toshiba Satellite

First Looks

T1900C may be your machine. The T1900C's 9.5-inch, dual-scan passive-matrix color screen is fine for a user who doesn't need to share the screen with onlookers; you might even mistake it for an active-matrix display.

With 4MB of RAM and a 120MB hard disk included, the 20-MHz 486SX-based Toshiba Satellite T1900C sells for about \$2,500. Other features, such as a Type III PCMCIA expansion slot and 3.3-volt technology in key components (CPU, video chip, RAM, and video RAM) make the T1900C a thoroughly modern notebook.

The T1900C weighs approximately 8 pounds with its AC adapter and 6.8 pounds without. The case measures 1.9 by 11.8 by 8.3 inches (HWD). System RAM is expandable to 20MB, and a 200MB drive is also available. Rather than use an integral trackball, Toshiba ships the T1900C with a Microsoft BallPoint Mouse with the QuickPort connection.

Dual-scan passive-matrix screen technology (Toshiba calls it Dynamic STN color LCD) looks brighter and has less ghosting

than conventional passive-matrix screens; it also consumes less power and costs less than active-matrix screens. An excellent compromise in Toshiba's implementation, this 16-color VGA screen is fine for individual Windows users.

Other notable features include loss-proof sliding port covers, a great keyboard, and Toshiba's full range of power management features.

The T1900C's 2.4A amp nickel hydride battery lasted 3 hours 5 minutes on the ZDigit test with power management enabled. Benchmark testing yielded results typical of 20-

formance notebook, nor is its screen quite good enough for portable presentations without an external monitor. But its color is good enough for Windows and its features make it a great value.

• List price: *Toshiba Satellite T1900C with 4MB RAM, 120MB hard disk, DOS 6.0, Microsoft Windows 3.1, Microsoft BallPoint Mouse, \$2,500 (estimate).* Toshiba America Information Systems Inc., P.O. Box 19724, Irvine, CA 92713; 800-334-3445, 714-583-3000.

Circle 431 on reader service card

Zeos Contenda 486

BY TIN ALBANO

When buying a subnotebook, a cramped keyboard and a poorly lit (or sometimes nonlit reflective) screen are generally accepted in exchange for greatly increased portability. With Zeos International's highly portable \$1,995 Zeos Contenda 486, however, neither sacrifice must be made.

The compact, 1.7- by 9.7- by 6.1-inch unit weighs in at a carryable 3.9 pounds (5.7



BRIGHT AND SPRINGY: Contenda features a well-lit screen and responsive key.



THAT'S PASSIVEP: Dual-scan technology produces the T1900C's crisp display.

MHz 486SX-based notebooks. The T1900C isn't a killer per-

pounds with the AC adapter and external floppy drive). Powered by Intel's 25-MHz 486SL processor, the Contenda turned in respectable performance scores on our benchmark tests. It's the very manageable keyboard and bright screen, however, that separate this subnotebook from others currently available.

Comfortable, full-sized letter keys and dedicated function and cursor keys are all neatly designed into a responsive, 80-key keyboard with a built-in trackball. You will need to get used to the in-line cursor keys—a real anachronism since most vendors now incorporate the inverted-T layout—but this is only a minor obstacle.

While respectable, the Contenda's 4 hour 33 minute ZDigit Rundown time probably suffered a little because of the machine's backlit screen. The Contenda's 7.4-inch, Sharp-manufactured screen supports 64 shades of gray.

Zeos offers a one-year warranty, round-the-clock technical support, and a 30-day money-back guarantee.

• List price: *Zeos Contenda 486 with 4MB RAM, 80MB hard disk, 3.5-inch external floppy disk drive, DOS 6.0, Microsoft Windows 3.1, Lotus Organizer, \$1,995.* Zeos International Inc., 1301 Industrial Blvd., Minneapolis, MN 55413; 800-423-5891, 612-633-4591; fax, 612-633-1325.

Circle 432 on reader service card

Benchmark Tests: Notebook Computers

For out-and-out power, nothing comes close to the TI TravelMate 4000E with its 486DX2/50 processor. The AcerNote 750c has the longest battery life; to compensate for the weight of an active-matrix screen, Acer uses a 1.5-pound battery.

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.1, to measure each PC's processor, memory, video, and disk subsystem performance. The DOSmark is a composite rating derived from these four scores. The Graphics Winmark is based on ten Windows graphics and text functions.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Video (millions of operations per second)	Disk (kilobytes per second)	DOSmark	Graphics Winmark (megapixels per second)	Battery Rundown (hours:minutes)	ZDigit Rundown (hours:minutes)
AcerNote 750c	6,472	4,510	3.90	24.74	23.53	3.80	2:08	5:12
CompuAdd 425TX	6,351	8,932	2.70	16.26	18.96	3.10	2:03	3:46
TI TravelMate 4000E	12,576	8,420	3.50	28.26	32.08	4.70	1:58	3:02
Toshiba Satellite T1900C	5,035	3,110	2.80	20.44	18.58	3.00	2:18	3:05
Zeos Contenda	5,994	3,924	4.23	20.87	20.42	4.40	2:36	4:33
486SX/25 historical average	5,483	3,985	2.27	19.26	18.90	2.42	2:23	3:48



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Them.

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Tektronix

■ Graphics

CorelDRAW 4: Graphics From A to Z in One Package

BY LUISA SIMONE

The latest release of CorelDRAW, Version 4, lives up to its reputation as the easiest-to-use, most innovative drawing program on the market. Once again, Corel Systems Corp. has added a host of new features without disturbing the accessible interface or raising the program's \$595 price tag.

The same nine tools that appeared in Version 1.0 are found in Version 4's toolbox, but now, toolbars and roll-up palettes provide access to power features such as fractal fill patterns, defined paragraph styles, painterly brushstroke effects, and dimensioning tools.

Fractal textures are without a doubt the snazziest new feature in CorelDRAW 4. You can create thousands of spectacular patterns by changing the parameters of 45 basic fractal styles. In addition, Corel's standard gradient fill tool has been improved with conical blends, rainbow blends, and customized blends that can contain multiple color transitions. Besides being just plain fun, the new gradients and fractal textures are reminiscent of 3-D modeling programs in that they allow you to render your 2-D wire-frame drawings with realistic bit-mapped surfaces.

Of course, fractal textures are bitmaps, and as such exhibit all of the performance and resolution problems common to raster images. If you want to produce high-resolution bitmaps, you may be disappointed with CorelDRAW's 120-dot-per-inch limit. And when applied to large

objects, fractals can seriously degrade system and printing performance.

If fractals are painterly fill patterns, the new PowerLine feature is best described as painterly brushstrokes. CorelDRAW renders each line you draw based upon the PowerLine profile you choose. This lets you easily change the shape of the line using standard node editing tools or modify the feel of a line by choosing one of 24 predefined styles. PowerLines also let you record brushstrokes directly by supporting pressure-sensitive devices, such as the Wacom tablet.

NEW DTP FEATURES

Each iteration of CorelDRAW has included more desktop publishing functions. Version 4 supports documents up to 999 pages long, can display spreads on screen, and can link text frames to flow copy from page to page. Creating and formatting multi-page documents is made easier by new text import filters for word processing programs and

text across frames, lack of hyphenation controls, and slow text screen redraws make it difficult to use for long documents.

Moreover, the only way to create irregular text wraps is to wrap paragraph text within an envelope. This feature is great for creating special effects, especially when you realize that you

high-flying new features, CorelDRAW 4 also fine-tunes the basic drawing functions. Node Editing commands now appear within a roll-up palette and can remain on-screen as you switch between tools. A small but great new feature, AutoReduce, lets you quickly clean up a long path that contains too many nodes. You can now select and edit objects while they are still inside a group by pressing the Control key and clicking the mouse. Best of all, when you create a defined style you can save not just paragraph text attributes but artistic text, outline and fill styles, and even enveloping and perspective effects.

CorelDRAW may still be the star of the show, but the ancillary programs that ship with it have graduated from bit-player status to featured actors. CorelPhoto-Paint, CorelChart, CorelShow, CorelMosaic, CorelTrace, and the newest addition to the Graphics Toolkit, CorelMove, share a common philosophy that emphasizes automated effects and cross-program integration.

It's now easier to learn and use the wide variety of tools because all of them sport similar toolboxes and roll-ups. Full support of the brand-new and more robust OLE 2.0 spec actually delivers two benefits. It gives you the power to link and embed objects between programs in the Corel suite, but it also means that certain functions—such as fractal textures and the much-improved print facility—are available no matter which program you happen to be using.

A simple laundry list of the features found in the various Corel applications is an embarrassment of riches. CorelMove lets you easily assemble .AVI videos. If you have mastered the idea of nodes on a free-form path (the basis of all objects created in CorelDRAW) you can make objects travel across the screen in CorelMove. Beginning users will love the 23 animation libraries that contain cartoon characters, props, and .WAV

FACT FILE

CorelDRAW Version 4.0

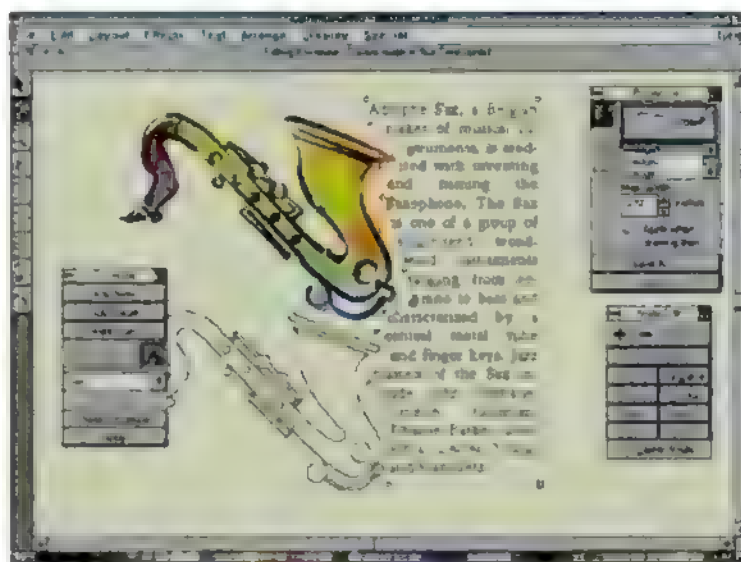
Corel Corp., 1600 Carling Ave., Ottawa, Ontario K1Z 8R7, Canada; 800-772-6735, 613-728-8200; fax, 613-761-9176

List price: \$595; CD-ROM version, \$549; upgrade, \$249.

Requires: 4MB RAM (8MB recommended), 8MB hard disk space (minimum installation; 36MB for full installation), Windows 3.1, mouse or digitizing tablet.

In short: Fractal textures, new toolbars, and better fills improve CorelDRAW 4.0. There's more of everything, and it's all still easy to access.

ON READER SERVICE CARD



ARTISTIC LICENSE: Fractal-based texture fills transform ordinary vector clip art.

by defined paragraph styles.

With these features, Corel may supplant entry-level DTP programs, but it won't replace high-end layout programs such as PageMaker or QuarkXpress. The program's inability to select

can use any outline—including clip-art images—to instantly create a text envelope. But without automatic text wrap around objects, integrating words and pictures becomes a real chore.

SCHEMATIC DRAWING

In the last year, a new segment of the graphics market has emerged—diagrammatic and schematic drawing. CorelDRAW 4 attempts to compete with programs like Aldus' IntelliDraw and Shapeware's Visio by offering a few key features. Scaled dimension lines, drag-and-drop symbol libraries, the ability to clone objects, and an object-level datasheet let you quickly generate org charts and flow charts, and even tally the cost of furniture in an office floor plan. But again, there are limitations to these tools. For example, Corel's dimension lines are not associative.

In addition to all of the

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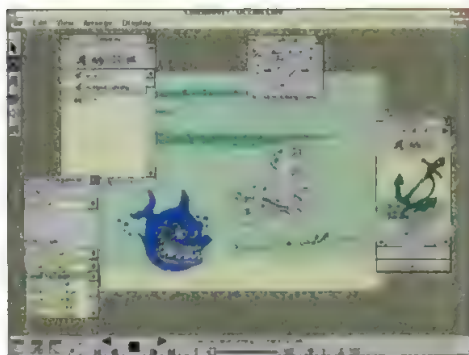
First Looks

sound bites. More advanced users can create new objects by using the built-in bit-map editor or by invoking CorelDRAW via an OLE link.

In addition to converting bit-mapped images to vector drawings, CorelTrace offers modest OCR functions that can convert scanned letters into true text.

CorelChart delivers a 1-2-3 punch with more than 40 mathematical and financial functions, pictographs that utilize CorelDRAW symbols, and the ability to create tables by formatting worksheets directly.

CorelShow lets you create branches, play animations within a frame, and apply transition



EASY ACCESS: Familiar roll-up palettes help you quickly master CorelMove.

effects to single objects. But Corel Photo-Paint is by far the most improved program of the bunch. It offers better selection tools, resampling capabilities, and Twain scanning support than before, along with 17 new image-editing and special-effect filters.

Just when you thought Corel couldn't fit any more value into

one box, it did. Two CDs contain 750 TrueType and Type 1 fonts, over 650 of which are Bitstream and ITC fonts. The symbol and clip-art library has been expanded to 18,000 images. Twenty-three animation libraries contain over 125 .WAV sound files. And there are literally hundreds of miscellaneous cartoons, backgrounds, and Autodesk animation files.

While these bundled programs can't compete on a feature-by-feature basis with high-end standalone programs, they do provide an amazing range of functions that are powerful enough for many business applications.

Our complaints about CorelDRAW 4 are few. We found that

the convenience and cross-program functionality of Corel's OLE links are offset by a noticeable degradation in performance. Corel also needs to offer more intelligent control over

complex PostScript clipping paths (which are the most common cause of printing errors) from within the Print dialog box.

In a move that is sure to shake up the graphics market, CorelDRAW 3.0 (a *PC Magazine* Editors' Choice) will continue to be sold as an entry-level drawing program, with a list price of only \$199. But whether you decide to buy Version 3 or Version 4, you can be sure that you'll be getting more than your money's worth.



From July 26 through July 30, you can go on-line to download a demo of CorelDRAW 4 or to discuss the program with Luisa Simone and Corel product manager Susan Wimmer. Type GO ZNT:EXEC from any CompuServe prompt.

Mathematics

Matlab Focuses on Matrix-based Math

BY BARRY SIMON

Matlab, Version 4.0, the first Windows version of The Math Works' \$1,695 mathematical software package, maintains its dependence on matrices and its reliance on state-of-the-art numeric algorithms.

Matlab doesn't have the symbolic power that makes other high-end math programs such as Mathematica so attractive, but its speedy numerics make it the ideal tool for some repetitive numeric calculations, and its support of sparse matrices make it the only tool for analysis of problems described by such matrices. Its graphics are strong, too. In fact, its sophisticated lighting and shading algorithms surpass those in Mathematica.

You communicate with Matlab in two ways: interactively via a command line, or through programs you write called M-files, which are sets of commands in ASCII format.

Many of the Matlab com-

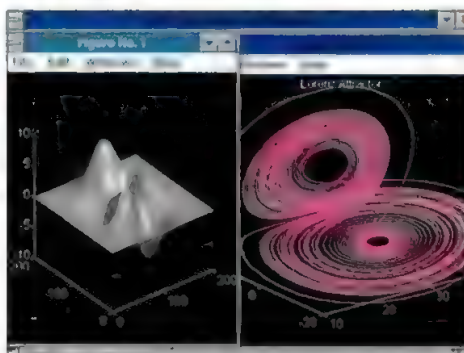
mands are implemented in M-files using a built-in core of fundamental commands. This is true in Mathematica (and in Maple, too), but Matlab has a big advantage in simplicity. Mathematica and Maple require you to remember what is in each library and load libraries explicitly. Matlab keeps a path of directories in which to search for M-files and looks for an M-file when you enter a command verb that isn't in the core.

Matrices, rectangular arrays of numbers, are the central object of Matlab. Matrices

and their special case, vectors, are central to much of mathematics and, even where not central, can be used as scaffolding. For example, the graph of a function can be described as

plotting one vector against another, and surfaces can be described by square arrays of numbers—the value of the function over a 2-D grid of points.

While this insistence on matrices everywhere has an intellectual coherence, it's some-



SEEING NUMBERS: Matlab's graphics include sophisticated lighting and animation.

times awkward. You can't plot a function just by giving a range and grid size. You have to explicitly set up the grid. It's only involves a few commands, but it's unnatural.

Matlab places the graphs it creates in windows, which it then treats as objects. You can change colors, rotate the viewpoint, and add text. You can even add your own submenus to the graph windows and your own buttons.

The program includes all the standard 2-D and 3-D graph types, including log, polar, contour, and surface plots. Many others—such as surfaces with projected contours—are also available. Matlab supports animation, which can be used to examine the dynamics of differential equations.

Matlab is well designed but pricey. Many users of high-end symbolic mathematical software need that symbolic functionality, but if your needs focus on sparse matrices, you will find Matlab in-valuable.

• List price: *Matlab for Windows, Version 4.0*, \$1,695. Requires: 4MB RAM (8MB recommended), 8MB hard disk space, math coprocessor, Windows 3.1. The Math Works Inc., 24 Prime Park Way, Natick, MA 01760; 508-653-1415; fax, 508-653-2997. Circle 404 on reader service card

■ Personal Digital Assistants

EO 440 Falls Short as Ultimate Handheld Communicator

BY CHRISTOPHER BARR

Under their skin they still have processors, memory, and hard disks, but no one wants to call them computers. Instead, new names are popping up: personal communicators, mobile companions, digital assistants.

AT&T's EO 440 (a joint project with EO Inc.) is the first of the new breed to come to market. Not a notebook, subnotebook, or organizer, the EO 440 is targeted specifically at the mobile professional who requires fax, e-mail, and voice contact while on the go. And although the EO 440 has been highly touted as the leader in this race (Apple's Newton and Tandy's Zoomer are still to come), when you use it you will quickly realize that it isn't quite hitting on all cylinders yet.

The EO 440 is based on the 3.3-volt Hobbit RISC processor from AT&T Microelectronics. An unadorned version of the

2.2-pound unit with 4MB RAM is priced at \$1,999, though without the ability to send faxes and e-mail, it's virtually useless as a personal communicator. With options and accessories such as a fax modem, a cellular phone, a 20MB hard disk, and a 10MB SunDisk PCMCIA storage card, the cost can shoot past \$4,000. The unit measures 0.9 by 7.1 by 10.8 inches (HWD).

The EO 440 uses an untethered active pen as the input device. Lose the pen and you can't communicate (a replacement pen is available for \$35). The unit has a nonbacklit 7.5-inch reflective LCD screen that requires adequate ambient lighting to be easily read. Power comes from a rechargeable nickel cadmium battery that will last about 4 hours between charges unless you use the cellular option, which will drain the power considerably faster.

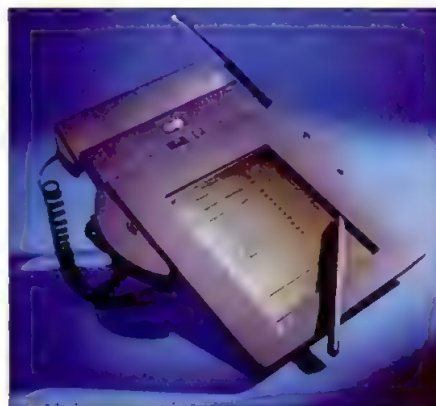
UNIQUE COMPONENTS

Standard ports include parallel, proprietary serial, PS/2-compatible keyboard, and telephone connections, along with a connector that accepts the wireless communications module. Attached like ears on either side of the display are a speaker and a microphone for voice annotation. The unit uses standard JEDEC DRAM cards and has one Type II PCMCIA socket that accepts SunDisk silicon hard disks.

The 5.0-volt EO 880, a larger, more powerful model, has a 9.4-inch backlit display, an external VGA port, and a SCSI II port. It can accept internal hard disks up to 64MB, and it has an additional PCMCIA socket.

The EO 440 runs GO Corp.'s PenPoint OS in 8MB of ROM, and it comes with nine applica-

tions. PenPoint supplies most of the key applications, such as Fax; Mail (which provides you an AT&T Mail account); Mini-Note, for jotting notes and making light sketches; MiniText, for handwriting recognition; and GOWrite, the handwriting recognition engine. EO Phone will dial both cellular and land-line telephones.



KEEP IN TOUCH: The EO 440 includes one Type II PCMCIA slot for extra storage.

Pensoft's Personal Perspective, a PIM, is also bundled. It includes a day planner and an address book that serves as the universal database for the telephone and fax numbers accessed by all your applications.

Communication is the EO line's raison d'être, and it falls short not in capability but in execution. On the positive side, it uses an inbox/outbox metaphor so you always know the status of your messages and have the ability to fax or mail from any document. But setting up either a land line or a wireless connection takes some doing.

EO Phone is a convenient way to make either cellular or voice calls from your unit. You can select a number from the address book, or tap in a number on the on-screen keypad. We

used the wireless connection to call in for voice mail, using the on-screen keypad to press the required voice mail commands, without a hitch.

The AT&T Mail account that comes along with the EO 440 has gateways to other public messaging systems, such as CompuServe and MCI Mail. The unique benefit of AT&T Mail is that you can both send faxes to and receive faxes from your mailbox and view them right on the unit.

The EO 440 has singular features that any e-mail junkie (who doesn't mind the lack of a keyboard) may covet, but many features are missing. It has no

print or fax preview and very limited printer support. The system performance is slow, with lots of tapping, clicking, and opening and closing of annoying dialog boxes and menus. There are few connectivity options. The EO 440 unit comes with SunSelect's PenCentral to connect to a PC, but you can't install a network card in the PCMCIA socket and

have a group of EO 440s communicating.

SOFTWARE COMING

It's likely that EO's first customers won't be in the mainstream of mobile professionals but rather in targeted vertical markets that will use the software development kit to create specialized communications-oriented applications. New applications, such as Notable Technologies' Mobile Access telecommunications package and Aha's InkWriter (which helps you edit handwritten notes) will make the EO 440 more attractive to the average user.

But today, on its own, the EO 440 is an expensive and incomplete (albeit intriguing) way to keep in touch with everybody, all the time. □

FACT FILE

EO 440 Personal Communicator

EO Inc., 800A Middlefield Rd., Mountain View, CA 94043; 800-458-0880, 415-903-8100; fax, 415-903-8190

List price: With 4MB RAM, \$1,999; with modem, \$2,499, with 8MB RAM, modem, \$2,799, with 8MB RAM, 20MB hard disk, modem, \$3,299

Options: Cellular module, \$799; floppy disk drive, \$199, AC adapter, \$99

In short: The EO 440 is the first in a new breed of integrated communications devices. Although it is based on groundbreaking hardware and software, its functionality is still quite limited, and it can be difficult to operate

426 ON-READER SERVICE CARD

Accounting

Peachtree, Release 2: Better Bookkeeping

BY KATHY YAKAL

Accounting software developers have tried to do the impossible for years: wrap an intuitive, simple, flexible interface and feature set around the rigid, cumbersome, complex process of double-entry bookkeeping. Peachtree Software's recently unveiled Release 2 of Peachtree Accounting for Windows (\$169) succeeds. Even when you consider its formidable competition, Peachtree's new cash management functions, ease-of-use features, and flexibility move the product ahead of the pack.

Peachtree 2 includes the standard accounting modules (General Ledger, Accounts Receivable, Accounts Payable, Report Writer), as well as functions not always managed well by entry-level business accounting systems: Inventory, Job Costing, and Payroll. While it's designed for small- and medium-size businesses with up to 25 employees and revenues under \$1 million, it can accommodate an unlimited number of employees and revenues up to \$999 million. Cash- or accrual-based accounting can be selected, and both batch and real-time posting are supported.

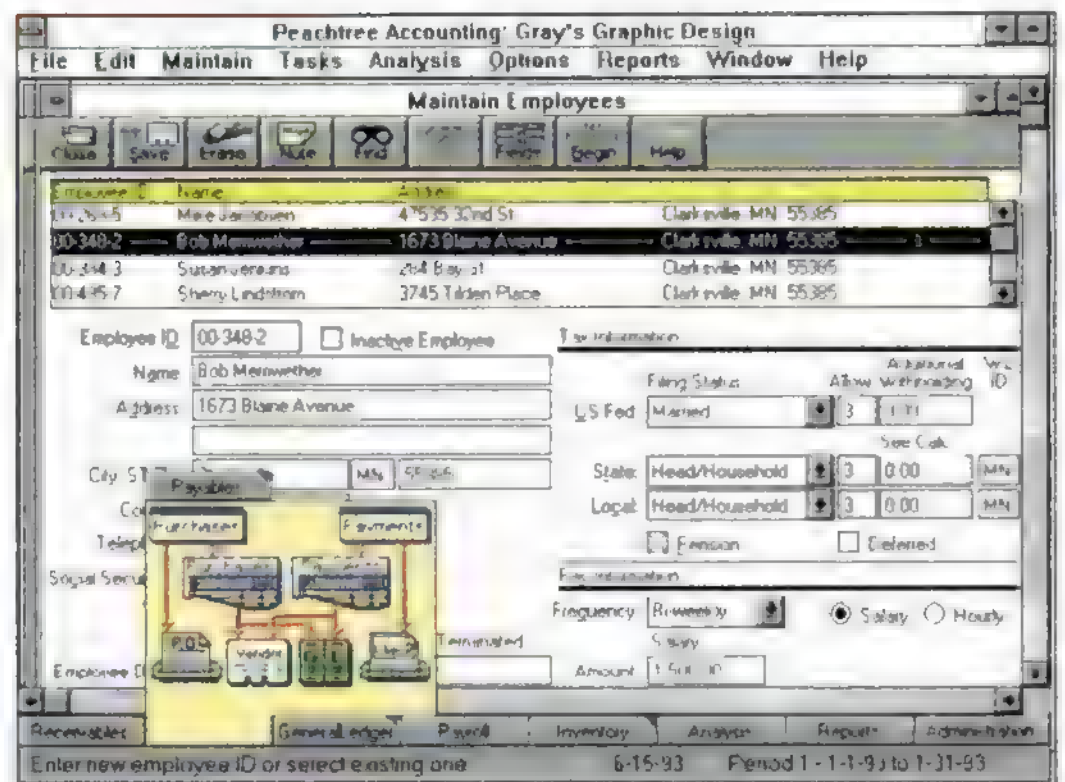
SOME KNOWLEDGE REQUIRED

Ever since the accounting process moved onto microcomputers, many vendors have claimed that their programs require no knowledge of accounting. This is a dangerous—and impossible—promise to try to fulfill. Peachtree 2, though, provides more guidance than most without offending the seasoned user. This latest version, which looks more like a brand-new program than an upgrade, includes a setup checklist that walks the

novice through the process of setting up a company for the first time. It also provides several sample Charts of Accounts, an on-line tutorial and sample data, and a "Smart Guide"—a dialog box that automatically pops up within potentially confusing screens. All of these features can be turned off.

Peachtree 2 also uses the Windows interface to better advantage than most accounting programs, which results in increased usability, flexibility, and customization. The new icon bar speeds up navigation. Miniature flowcharts pop up when you click on tabs at the bottom of the screen; these illustrate the path that data takes through the system. Moreover, they serve as an optional navigational aid. Click on the task you want to do and the program jumps you there.

Some of Windows' more powerful tools, DDE (Dynamic Data Exchange), OLE (Object Linking and Embedding), and



NAVIGATE: Tabs along the bottom of the screen bring up informational flowcharts.

the MDI (Multiple Document Interface), are all supported by Peachtree 2. This ability to exchange data with other Windows applications and keep multiple documents open and updated simultaneously can be a real boon to accounting software users, who may need to pull in data from spreadsheets or databases, look quickly back and forth between two or more screens, or import logos or other graphics for Peachtree 2's new customizable forms, reports, and financial statements.

BOTTOM-LINE BUSINESS

A clear, intuitive interface might sell products, but it won't build a base of long-time users unless the core accounting features are flexible and forgiving while still conforming to standard accounting principles and gently teaching you how to better manage your business.

Peachtree 2 offers new strength in both directions. It's added a Cash Manager, a Collections Manager, and a Payments Manager, which provide analysis along with graphical representations that illustrate how you're doing overall.

Unlike other programs, Peachtree 2 lets you keep up to two years open at once. It also offers an unusual "UnPost" feature (in batch mode only), which lets you edit transactions that

have already been entered.

Little things can mean a lot in an accounting program, considering the myriad ways small businesses keep their books. Most modules in this new version incorporate several small changes that make the program accessible to a larger group of users. You can record reversing entries in the GL, and track sales tax on multiple levels in A/R. You can print purchase orders and log pending P.O.'s in A/P. Vacation and sick leave can be tracked in Payroll.

Peachtree 2 contains several helpful features not offered by some of its most highly touted competitors. It provides a tax update service and prints 1099 forms. It's date-sensitive, making month-end closing unnecessary. And it's multiuser straight out of the box.

Still, Peachtree 2 isn't perfect. While the custom forms design option is a plus, it's difficult to use, and the graphics-intensive interface is an obvious drag on the program's performance.

If you're a loyal Peachtree user, you'll get more than your money's worth by upgrading for \$79. And if you're shopping for a new or first-time business accounting program, Peachtree Accounting for Windows, Release 2, should be at the top of your list. □

FACT FILE

Peachtree Accounting for Windows, Release 2

Peachtree Software Inc., 1505-C Pavilion Pl., Norcross, GA 30093; 800-228-0068, 404-564-5700; fax, 404-564-5880

List price: \$169

Requires: 2MB RAM, 7MB hard disk space, Windows 3.1.

In short: Peachtree Accounting for Windows, Release 2, takes a giant step beyond previous versions. A dramatic new interface, new help functions, and more flexible, powerful money management functions make it hard to beat for small business accounting.

423 ON READER SERVICE CARD

■ New On the PC Platform

NeXTStep Brings Objectivity to Operating Systems

BY STEVEN J.
VAUGHAN-NICHOLS

Choosing among high-end operating systems just got harder. If you think the choice between OS/2 and Windows NT (not to mention UnixWare and Solaris) is complex, now add NeXTStep for Intel Processors from NeXT to the mix.

First developed as the operating system of the now discontinued NeXT computer, the \$795 NeXTStep workstation operating system brings a distinctly different look and feel to today's PCs. With the arrival of NeXTStep, object-oriented operating systems are no longer the stuff of science fiction for PC users. It is just this design approach that makes NeXTStep an extraordinary development platform ready for corporate America.

Other than built-in networking, multimedia e-mail, true multitasking, and support for 24-bit true color graphics, what does NeXTStep deliver? First and foremost is a breathtaking interface—the Workspace Manager—that rivals and even surpasses that of the Macintosh.

However, one thing you won't get in this version is the ability to run MS-DOS or Windows programs. This was promised as an option through Insignia Solution's SoftPC, but it's one that won't be fulfilled until fall, when NeXTStep 3.2 appears (a free upgrade to registered users will be offered).

A WORLD OF OBJECTS

NeXTStep's interface is completely object oriented, which means that Workspace Man-

ager's individual elements—icons, menus, and windows—can be taken apart and sewed back together to form a customized interface.

For example, there's a "shelf" for files and an "application dock" for programs that resemble icon bars in Windows apps. But unlike icon bars, where you can place only predetermined program functions, NeXTStep's shelves accommodate any program, directory, or file for quick retrieval.

The object metaphor is carried beyond the interface. For example, linked editable items, such as documents, use Object Links (similar in concept to Windows' Object Linking and Embedding) to transport changes from a document to a spreadsheet automatically and transparently. Applications don't need to be aware of this facility

since it's built into the operating system.

A multithreaded, multiprocessing microkernel operating system called Mach makes the Workspace Manager run smoothly. Mach gives NeXTStep the ability to run multiple applications at once without the starts and stops that plague the performance of other operating systems that multitask applications.

On top of Mach is NeXTStep's version of Unix. Don't start sneezing if you're allergic to Unix: NeXTStep completely protects you from Unix's com-

WordPerfect, Mesa (a spreadsheet), and Gupta SQLBase Server are now available, to name a few. NeXT includes a catalog of apps along with a sampler CD-ROM in NeXTStep. It also comes richly endowed with its own apps: NeXTMail, a network-capable mail system that includes multimedia; an editor that works with ASCII and rich-text format files and displays .EPS and TIFF graphic files; VT-100 and 3270 terminal emulators; network system administration tools; an on-line version of Webster's Ninth New Col-

legiate Dictionary and Collegiate Thesaurus; and the complete works of Shakespeare.

NeXTStep is a truly rich package, but it's not perfect. Like any 32-bit operating system, there's a paucity of drivers. Though it has a more complete collection of video



ANOTHER OS: NeXTStep hides its Unix-based core with a great object-oriented interface.

plexities while preserving its file access structure and rich command set. Thanks to the Workspace Manager, most users will never know they're running Unix.

NeXTStep has superior interoperability features. Besides the TCP/IP and NFS client/server networking capacity it inherits from Unix, NeXTStep comes ready to step into existing NetWare networks as a NetWare client. And it can use not only Unix and DOS files, but Macintosh files as well.

DEVELOPER'S VERSION

The \$1,995 price tag of the separate developer's version of NeXTStep shouldn't scare off developers. The development environment and language—Objective C—make building programs from reusable objects as easy as building houses from Lincoln Logs.

NeXTStep isn't high and dry on the application side, either.

drivers than OS/2 2.1, it can work only with PostScript printers. One other oddity: NeXTStep can only work on a system with a single 3.5-inch high-density floppy disk drive. The 5.25-inch disk drive must be disabled if you have one.

NeXTStep doesn't belong on everyone's desktop. The massive system requirements alone (16MB RAM, 120MB hard disk space) put it beyond the reach of most users. Still, in testing, NeXTStep worked like a fine Swiss watch both in standalone mode and concurrently as a node on NetWare and TCP/IP networks. And adventurous programmers will be delighted with NeXTStep's development environment. We foresee NeXTStep taking a place similar to that of the Macintosh: an operating system that's not for everyone, but extraordinarily powerful and easy to use for those willing to travel a path away from the mainstream. □

FACT FILE

NeXTStep Release 3.1 for Intel Processors

NeXT Inc., 900 Chesapeake Dr., Redwood City, CA 94063; 800-879-6398; 415-366-0900; fax, 415-780-3714

List price: \$795; developer's version, \$1,995

Requires: 16MB RAM (24MB recommended); 120MB hard disk space (200MB recommended); 486DX processor or better; SCSI CD-ROM drive

In short: The first PC-based version of NeXTStep has intriguing interface twists and the ability to multitask flawlessly. The catch: It doesn't run DOS and Windows apps


ON READER SERVICE CARD

The Heat Is On!



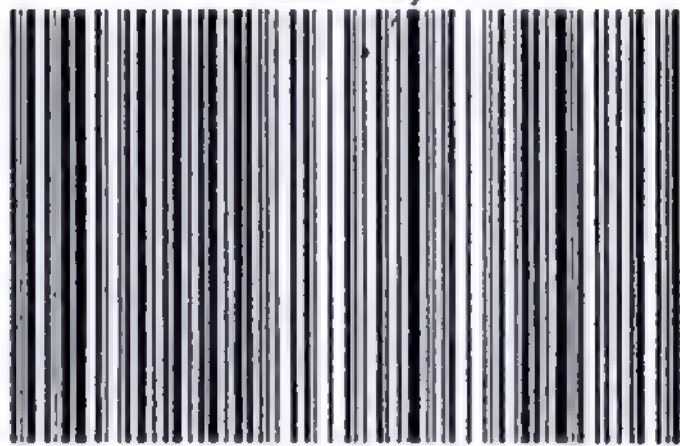


Gateway 2000's summer fun ad was inspired by our stock car racing team. As you might guess, we don't spend millions on an Indy car. Ours is an all-employee team that runs on local dirt tracks. The team races pretty much the same way Gateway operates: they're competitive and successful, but they always have fun!

1. Follow instructions on the other side

Back

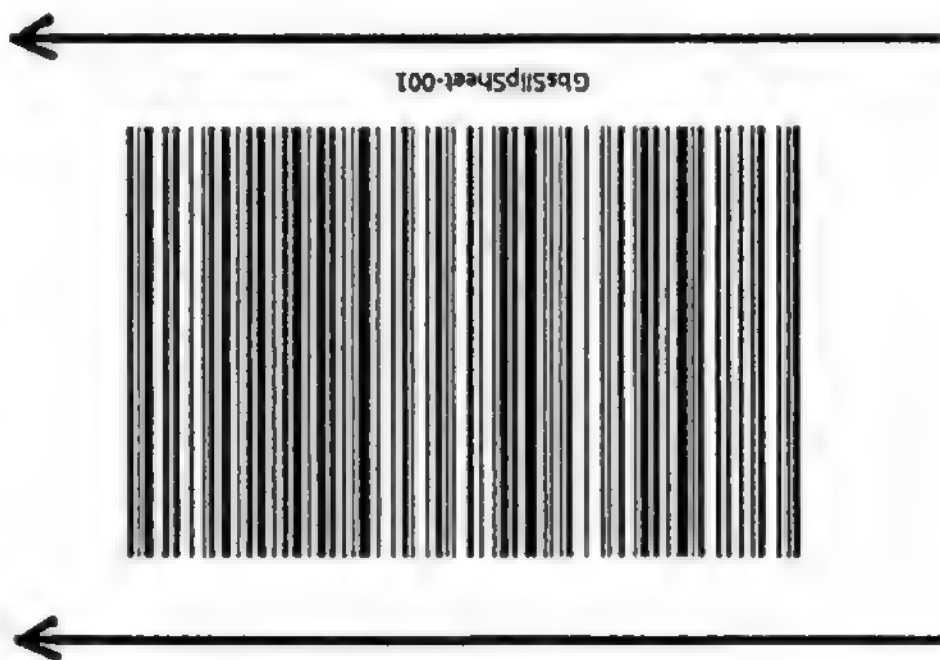
GbslipBack-001B



Inverted Back

1. Follow instructions on the other side

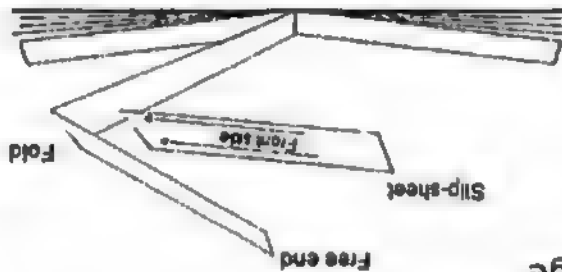
Folded edge of the page



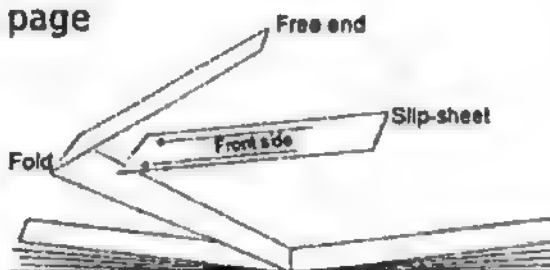
Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



They're In Hot Pursuit Of The Value Leader...



But Gateway Outmaneuvers The Competition — And You Win!

In the fast-moving, hard-driving PC industry, the race for leadership is more competitive than a heat at your local stock car speedway. All classes of PC manufacturers are on the direct market track together, trading paint and slamming each other into the wall at every turn. Competitors big and small are being black-flagged and sent to the pits in record numbers this year.

All the while, season after season, the unassuming cow-spotted Gateway car consistently outmaneuvers and overpowers the competition. Repeatedly, Gateway 2000™ leads the field by providing you with the best value in the PC industry. When Gateway takes the checkered flag in this race, you're the winner!

weight get out of control (unlike some competitors). We've carefully maintained our unique, low-overhead business model with no extra parts to slow us down. The Gateway machine handles extremely well, too. We can move faster through the marketing corners without getting out of control, all of which saves you money when you buy from Gateway.

Our competitors would like to have you think they're now offering a value that meets or beats Gateway. But apples to apples, they're still hundreds, sometimes thousands of dollars more, while our systems consistently outperform theirs.

You're a smart shopper. Do the comparisons yourself and you'll confirm what Dataquest™ found in a 1993 customer satisfaction survey: Gateway ranked number one for best pricing. When you add the other buying criteria that's important to you, Gateway offers an unbeatable value.



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Our price-performance ratio is even better this month thanks to improved graphics on our highest performance systems. We replaced ATI's Graphics Ultra Pro, the industry's leading graphics card, with ATI's latest-generation Graphics Ultra XLR. The new XLR is

up to twice as fast as the Ultra Pro, and it's the best all-around DOS and Windows™ video performer in the industry.

The ATI™ Graphics Ultra XLR is also multimedia ready, enhancing and

accelerating video for Windows through hardware. When viewing motion video, you can enlarge your window size to full screen without decreasing your frame rate, getting jaggy edges, color distortion or losing audio sync.

for example. In automotive terms, this system is a top fuel dragster. It has won 11 major industry awards, and they just keep coming because the 4DX2-66V includes the best of everything at a terrific price. Another example is our Nomad 450DXL. This portable is in the off-the-road vehicle category, but its 50MHz 486 DX2 processor makes its engine that of an open-wheel racer. We'll have colorful, new sprint cars ready to enter in the upcoming notebook and HandBook® races. Watch for them!

That's the Gateway price-performance ratio, and it's equally good across our entire product line.

Compatibility & Upgradeability

We understand compatibility and upgradeability are important to you. You can relax with Gateway. When Dataquest asked 833 PC users in Fortune 500 companies to rate personal computer companies, they ranked Gateway number one in the areas of compatibility, upgrade potential and price. All Gateway systems go through extensive compatibility testing to ensure flawless performance with all products from major software developers and peripherals manufacturers. And we give you a *written guarantee* that our 486 systems are upgradeable to Pentium technology. Ask us about it.



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Mike Schmith, Gateway 2000 Marketing Manager, drives the Gateway race car. "Schmittty" says the race to market with the very best products for Gateway is even more intense than his weekends behind the wheel.

Gateway's Award-Winning Team Is Behind You All The Way.

Reliability & Quality

We understand you want reliability and quality, in both the products you buy and the company you buy them from. That's what you get with Gateway. In the two most recent reader surveys conducted by *PC Magazine*, Gateway systems received the highest ratings for reliability. We earn these awards because we use only the best quality

Service

We understand you want the best in service, from your first phone call through the years you own your computer. You can count on Gateway to live up to your expectations. Our representatives are mostly Midwest born and raised, and it shows in the friendly, caring way we work with customers.

Every Gateway 2000 system comes with excellent after-the-sale support. You get a 30-day money-back guarantee. If you don't like your system, send it back within 30 days for a refund.

All systems come with a one-year limited warranty and telephone technical support for the life of the system. When you need

help with your PC, whether it's not working or you just have a question, you

want a fast, skilled crew waiting for you in the pits. That's what you get with Gateway's award-winning technical department. We received *PC World's* World Class Award in 1992 for best service and support in the hardware category. In a February 1993 survey, *PC Magazine* readers once again gave Gateway an excellent rating for service and reliability. And in June, *BYTE* readers echoed the other awards, choosing Gateway 2000 as the company that provides the best service in the industry.

components in our computers, and they're manufactured with Midwest pride and painstaking quality-control procedures. Gateway 2000 is also one of the most financially stable companies in the industry, assuring you that you're buying from a reliable manufacturer that can withstand the rigors of the PC Racing Series.



You've got a friend in the business™

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Brent Culbertson, a Gateway 2000 Tech Support Supervisor, is Crew Chief on the race team. He spends weekends keeping the Gateway car running, weekdays keeping your systems running.

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- Windows Accelerated Video w/ 512K DRAM
- 14" Color CrystalScan® 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey® Keyboard & MS Mouse
- MS-DOS® 6, Diagnostics & Windows™
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- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows
- MS Works for Windows 2.0

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- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
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- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows
- MS Works for Windows 2.0

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4DX-33V

- 33MHz 486DX Intel Processor
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- Local Bus IDE Interface
- Intel Pentium Technology Ready
- Windows Accelerator w/ 1MB DRAM on VL-Bus™
- 14" Color CrystalScan 1024NI
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows
- MS Works for Windows 2.0

\$1995

4DX2-50V

- 50MHz 486DX2 Intel Processor
- 8MB RAM, 128K Cache
- 5.25" & 3.5" Diskette Drives
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- ATI™ Ultra XLR Video w/ 1MB VRAM on VL-Bus
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows
- Choice of Application Software

\$2295

4DX2-66V

- 66MHz 486DX2 Intel Processor
- 16MB RAM, 256K Cache
- 3.5" Diskette Drive
- CD-ROM Drive
- 424MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- ATI Ultra XLR Video w/ 1MB VRAM on VL-Bus
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows on CD
- Choice of Application Software

\$2995

4DX2-66E

- 66MHz 486DX2 Intel Processor
- 16MB RAM, 256K Cache
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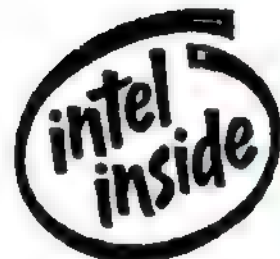
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All hard drive sizes are manufacturer's specified capacities. Microsoft MS-DOS 6 can increase hard drive capacity through software compression.

This year's summer fun ad was photographed at Park Jefferson International Speedway, a NASCAR-sanctioned track just a few miles from the Gateway 2000 plant. Our thanks to Park Jefferson people and local stock car drivers for their participation.

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Personal Finance

Free Software? That's Good Money Management

BY CHRIS SHIPLEY

Before you read any further, pick up the phone and dial 1-800-FREE-MONEY. If you are lucky, you'll be one of the first one million people to call and get a free copy (actually \$6.95 for shipping) of Computer Associates' new Kiplinger's CA-Simply Money.

It's no secret that a free copy is the best way to give any software a trial run, but it's an especially good idea when the product is unlike anything in its category. The Windows-based Simply Money (normally \$69.99) is a case in point. To date, personal finance software has taken the paper checkbook and made it a metaphor for PC-based personal finance management. While you can find an on-screen check in Simply Money, the dominant metaphor isn't a checkbook. Instead, it's icon buttons that you click and drag around the screen to manage your financial chores.

Need to set up an account? Click on the account button, drag it across the screen, and drop it on the setup icon. Want to write a check? Click on the checking account button and drag and drop it onto the check-writing icon.

The true test of any interface, of course, is whether the approach works. Checkbook interfaces work because they're familiar; most people pay their bills by writing checks, after all. But icons? We put Simply Money through the same testing script we used to evaluate checkbook-based personal finance software earlier this year ("Tracking Dollars with Sense,"

January 12, 1993). Simply Money fared as well as Quicken and Managing Your Money and better than many others in the category.

FINANCIAL COACHING

A click-and-drag button interface may seem odd at first, and certainly it's not immediately intuitive. Simply Money gets you over that hurdle by making liberal use of on-line "coaches" to help you set up and manage accounts. The program is packed with hints that tell you how to use it. Then it takes the coach concept further by including a pop-up Financial Advisor loaded with common-sense advice (the Kiplinger organization is credited with these handy tips). The coaches can get tiresome after a while, so Simply Money does let you turn them off.

What the coaches don't help you with, the automated and predefined features will. Where other finance managers provide a basic template, which you modify for specific account types, for example, Simply

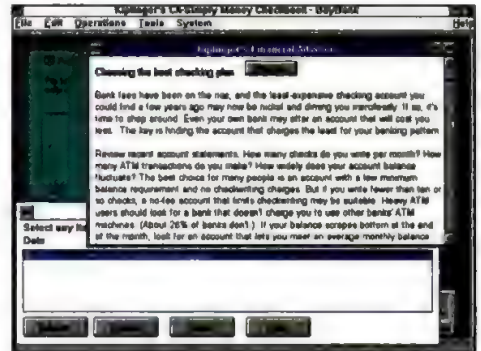
Money does the setup for you. The program includes predefined accounts for checking, savings, investments, mortgages, credit cards, and a handful of other formats. That's only the beginning. Simply Money, like other financial programs, memorizes transactions, so you'll only have to enter payee data one time. It also provides overdraft protection that alerts you when you are about to write a check that puts you in the red, and it gives you a variety of predefined reports to give you the big picture on your finances.

Our chief concern with Simply Money's push-button approach was the possible tedium. After all, clicking and dragging can get old pretty quickly. Surprisingly, with Simply Money it doesn't. And if you prefer, you can work around it easily enough by choosing tasks from the program's operation menu.

DOWNLOADING STOCK PRICES

Programs that are this automated sometimes focus on fairly low-end chores, such as check writing and account balancing. Simply Money starts with the basics but also handles more

complex tasks with aplomb. It may not be the most robust investment analysis package, for example, but it has a number of investment management features not found in Intuit's Quicken—namely communication links to electronic stock price updates. Additionally, the program handles links between checking and loan accounts remarkably well, maintains amortization schedules for



ADVICE: The program includes financial hints from Kiplinger's.

loans, and includes a handful of useful financial calculators.

Simply Money is noticeably weak in only one area where competing packages shine: tax planning. You can export data to tax programs, but Simply Money doesn't handle tax calculations on its own—a feature that's important for those who get serious about their money management.

Nevertheless, Simply Money is a surprisingly adept personal finance package. If you like the feel of the checkbook metaphor, stick with Quicken or Managing Your Money. But if you want simplicity in a fun-to-use package, Simply Money is worth a try. Especially if you can get it for free.

• List price: Kiplinger's CA-Simply Money, Version 1.0, \$69.99. Requires: 2MB RAM, 4.5MB hard disk space, Microsoft Windows 3.1. Computer Associates International Inc. One Computer Associates Plaza, Islandia, NY 11788; 800-225-5224, 516-342-5224; fax, 516-342-5329.

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HOME BASE: Simply Money uses icons and buttons intensively.

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■ Groupware

WorkMAN Lets the Office Tasks Flow

BY GREG PASTRICK

Reach Software Corp.'s WorkMAN, Version 1.0, is one of a growing number of group-shared applications that provide the connectivity tools needed to organize and distribute everyday business tasks and information.

Simply put, WorkMAN is a workflow management system built on a common e-mail backbone. System administrators can build custom WorkMAN applications such as check requests, project status reports, or expense reports that match an organization's existing business structure.

The program's two main components, the \$2,495 WorkMAN platform and the \$995 WorkMAN Tools, work together with Novell's MHS or Banyan's VINES messaging environments to help work flow smoothly among groups. WorkMAN sends and receives information contained in standard office forms (announcements, check requests, memos, expense reports) and handles all the steps in between, including creating, processing, routing, and tracking the forms.

As a Windows 3.1 application, the WorkMAN desktop platform supports Dynamic Data Exchange (DDE); uses

familiar pull-down menus, icon button bars, and windows; and presents a graphical display of a variety of business forms. A key component of the platform is WorkMANager, which controls the interaction of tasks (entering information, signaling approval, sending along the information, and so on) and the shared library of WorkMAN applications.

Since forms are the common currency of most interoffice communications, the desktop application comes with a sample forms-router program to demonstrate how information is routed and tracked. It also has tools for creating original forms quickly and for assigning tasks to workgroup members.

WorkMAN Tools, a set of utilities and object-oriented programming pieces based on a C-like scripting language, are designed for the system administrator, VAR, or developer who builds original applications to fit the structure and organization of the small group or office. Reach Software offers a special developer training program that includes three days of instruction in using WorkMAN Tools.

WorkMAN achieves its goal of giving workgroups a logical, efficient method of distributing tasks. If you already know how

to use basic e-mail, you'll be able to create automated workflows with WorkMAN. Administrators need to have more technical knowledge than workgroup members to install, maintain, and customize the workflow system and its applications.

• List price: *WorkMAN, Version 1.0*, 5-user license, \$2,495; additional 5-users, \$1,495; *WorkMAN Tools*, \$995 (single developer); training package, \$1,995 (includes training, 5-user base platform, tools, and 12 months support and updates). Reach Software Corp., 872 Hermosa Dr., Sunnyvale, CA 94086; 800-624-5356, 408-733-8685; fax, 408-733-9265.

Circle 402 on reader service card

■ Video

Hercules Tries Two New Ways to Speed Windows

BY BEN MYERS

The latest Hercules VL-bus graphics adapters present a stark contrast in graphics hardware design and price. The \$399 Graphite VL uses 1MB of 70-nanosecond video RAM (VRAM) graphics memory and the AGX015 graphics engine, IIT's latest spin on the IBM XGA design. The \$249 Dynamite VL is equipped with 1MB of 50-ns dynamic RAM (DRAM) and is one of the first boards available to use the latest chip from Tseng Labs, the ET4000-W32.

Despite their differences, the cards share many features: support for applications that use the VESA BIOS; AutoCAD drivers; and Windows resolutions up to 1,280-by-1,024 with 16 colors, 1,024-by-768 with 256 colors, 800-by-600 with 65,536 colors, and 640-by-480 with 16.7 million colors. The DOS-based software installation utilities supplied by Hercules adjust each card for the type of monitor you have, install the VESA-compliant BIOS TSR, and copy software drivers and utilities into the right directories.

The Dynamite VL is a jumperless card, while the Graphite VL has jumpers to disable graphics IRQ 2 and to change the settings of some ports that it uses.

Dynamite VL ran without a hitch with a Western Digital IDE hard disk, an Adaptec 1542C ISA-bus SCSI host adapter, and an UltraStor 34F SCSI VL-bus SCSI host adapter. The Graphite VL didn't get along well with the 34F (the system crashed at startup); it did work properly with the IDE and Adaptec setups.

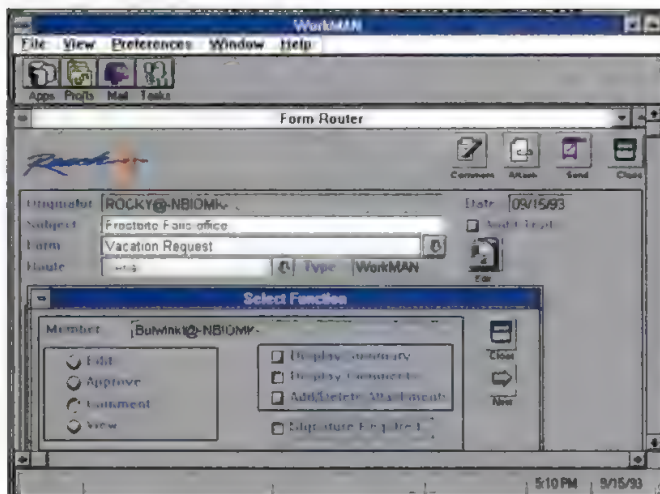
VRAM memory is supposed to allow noninterlaced operation with minimum flicker at higher resolutions and color depth, but the Dynamite VL's refresh rate surpassed the Graphite VL's.

The Dynamite VL yielded a Graphics Winmark score of 16.2 megapixels per second at 800-by-600 resolution with 256 colors when installed in a Micronics VL/EISA motherboard in a 33-MHz 80486/DX2. The Graphite VL had a Graphics Winmark score of 15.6 megapixels per second.

Considering its ease of installation and performance, the Hercules Dynamite VL is a better deal than the Graphite VL, and it stacks up well against other graphics cards with a megabyte of on-board memory.

• List price: *Hercules Graphite VL*, \$399; *Hercules Dynamite VL*, \$249. Hercules Computer Technology Inc. 3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600, 510-623-6030; fax, 510-623-1112.

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CIRCLE 236 ON READER SERVICE CARD

■ Backup

Fastback 6.0 Brings Back Usable Menus, Adds Tape Support

BY EDWARD MENDELSON

Fastback Plus is once again a backup program that is easy to use. Version 6.0 of Fifth Generation System's \$149 DOS-based backup package abandons the confusing menu system adopted in Version 3.x, returning to an improved version of the drop-down menus used in the highly popular Versions 1 and 2 (Fifth Generation jumped from Version 3 right to Version 6).

The new version also adds support for QIC 40/80 and SCSI tape drives and lets you use the tape drive on any workstation in a network as a backup drive for all other stations.

In tests, Fastback Plus backed up and restored to floppy disks at speeds only marginally slower than the DOS versions of The Norton Backup 2.2 and the Central Point Backup program included in PC Tools 8.0. Using the default settings, Fastback took almost twice as long as Central Point to back up and verify 650MB of data to a SCSI tape drive, but the speeds became roughly equal when Fastback's compression was turned off.

Fastback was markedly slower than Central Point in restoring files from tape because Fastback, unlike Central Point and most other SCSI backup programs, doesn't write a catalog of file locations on the tape for access during restores.

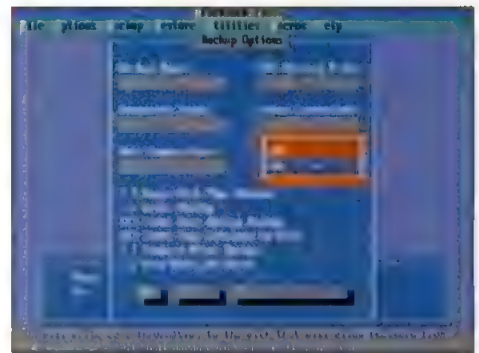
Fastback surpasses its rivals in the clarity and flexibility of its file-selection menus. You can use those menus to delete files, as well as copy them or back them up. Fastback comes with an effective macro language that can be programmed to display messages on-screen, although it doesn't include branching. A TSR scheduler lets you launch unattended backups or complex

macros for backups and restores.

The program doesn't have a fully finished feel. The built-in file viewer displays only ASCII files, and it will beep if you try to look at anything else. You still can't back up or restore individual files from the DOS command line, as you can with Norton and Central Point. But Fastback's flexibility in networks and its peer-to-peer

backups and restores via cable are features you cannot find elsewhere.

• List price: *Fastback Plus*, Version 6.0, \$149; upgrade, \$49. Requires: 640K RAM, 2MB hard disk space, DOS 3.3 or later. Fifth Generation Systems Inc., 10049 N.



EASY AGAIN: Fastback has clear menus.

Reiger Rd., Baton Rouge, LA 70809; 800-873-4384, 504-291-7221; fax, 504-291-5453.

Circle 424 on reader service card

■ Printer Enhancements

ZScript: Get Easier PostScript the Software Way

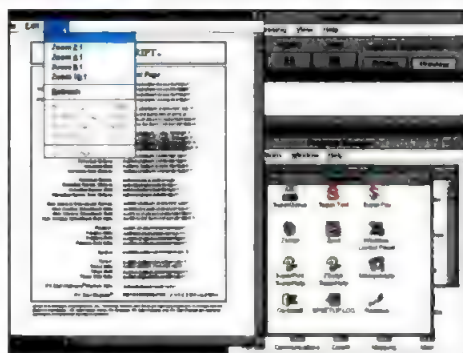
BY ROCK MILLER

A software PostScript interpreter can be a good alternative to a dedicated PostScript printer, and Zenographics' ZScript is a convenient and flexible implementation of this technology. For \$295 (including the company's SuperPrint 3.0 printer utility, also sold separately for \$149), the Windows-based ZScript lets you render PostScript documents on HP LaserJets and compatibles, on non-PostScript color devices such as the HP PaintJet, and even on CAS-compatible fax boards.

In design, ZScript is a techie's dream (or nightmare): an array of utilities that interact with one another in complex ways. ZScript is actually a customized version of Pipeline's PowerPage Postscript Level 1-compatible interpreter, which converts PostScript code for use with SuperPrint's newly optimized, 32-bit rasterizer. Its SuperText

utility provides facsimiles of the basic 35 PostScript fonts and works seamlessly with ATM and TrueType fonts. Additional drivers create phantom devices for direct printing from Windows and DOS applications.

In spite of all these components, ZScript is straightforward, smooth, and stable. In server mode, PostScript output from applications is captured on



PROOF IT: ZScript displays PostScript output in a preview window.

the fly into temporary files for printing in the background. You can also add PostScript documents on-disk to ZScript's queue, preview documents, and save them in Windows metafile format.

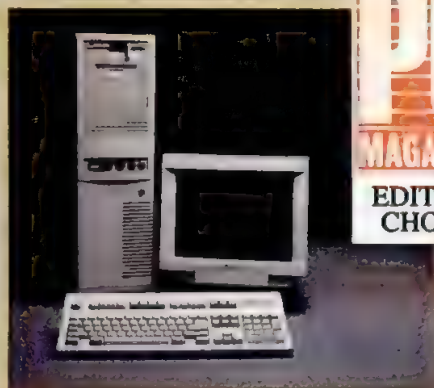
But its piecemeal structure

does put a burden on the installation procedure. Although the default installation worked fine, excluding certain options (such as the SuperFax driver) resulted in some glitches later on. The documentation, though well-written, is disorganized and does an inadequate job of helping you to sort through the options. Fortunately, there's an Uninstall utility, and the Masquerade utility makes quick work of reading your printer's paper-handling and font options.

For ordinary documents, ZScript's performance is comparable to dedicated PostScript solutions. On our 33-MHz 486 test system, ZScript's times to print a 16-page mixed-text document, a simple vector image, and even a full-page bitmap image just about matched the times turned in by Hewlett-Packard's PostScript Cartridge Plus for the LaserJet III. On a more complex vector image, ZScript showed a noticeable performance edge, an important consideration for power users with large color jobs to print.

• List price: *ZScript*, Version 1.0, \$295 (includes Superprint 3.0). Requires: 4MB RAM (8MB recommended), 5MB hard disk space, Windows 3.1; math coprocessor recommended. Zenographics Inc., 4 Executive Circle, Irvine, CA 92714; 800-366-7494, 714-851-6352; fax, 714-851-1314.

Circle 420 on reader service card



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EDITORS' CHOICE

PC Labs test 61 PCs AMAX won Editors' Choice



February 23, 1993
Amax 486DX2/50 ISAmex

June, 1993
486DX2/66

Olympic-class performance scores on PC Magazine Lab's benchmark tests, spacious expansion possibilities, and excellent components, the Amax 486DX2/50 ISAmex Power Station deserves a gold medal.

You'll certainly be impressed by the full size tower case. It holds eight drive bays and a 250-watt power supply, and you can easily expand this PC to your heart's content. The tower case also leaves you plenty of RAM and a 256K external SRAM cache already installed, you won't need to access it every much. If you want to upgrade your processor, the motherboard is configurable to any 486 processor via jumper setting.

AMAX 486DX2/50 ISAmex
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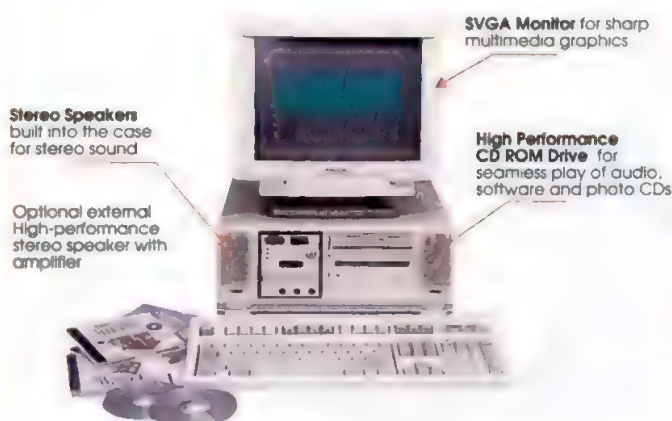
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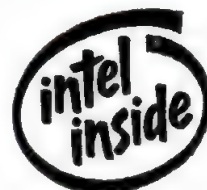
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■ Color Laser Printers

New Kodak ColorEase Prints Photolike Images, Naturally

BY M. DAVID STONE

Of all the technologies for color printing, thermal dye transfer produces output that is most like a photo. So it's only fitting to encounter a thermal dye transfer printer from Kodak. The ColorEase PS Printer definitely has Kodak quality, and its \$7,999 list price—20 percent less than the Tektronix Phaser IIsd—makes it a relative bargain.

The price is only part of the good news. The printer easily matches more expensive printers for speed, print quality, connectability, and more.

Thermal dye transfer printers have an immediate advantage over other types of color printers. Most color printers use dithered patterns, which reduces effective resolution since the eye interprets the dithering matrix as a single large dot. Thermal dye transfer printers don't use dithering patterns; instead, they overlay translucent dyes on top of each other.

The printhead heats a ribbon, turning dye to gas. The gas diffuses over the paper or transparency and is absorbed by a special coating. The result shows as continuous tones, rather than visible dots. And at 300 dots per inch, using 24-bit color (16.7 million colors), the technique yields a photo-realistic image.

Unfortunately, diffusion also blurs edges, and the technology's Achilles's heel is that thin lines in drawings or small-size text tend to break up.

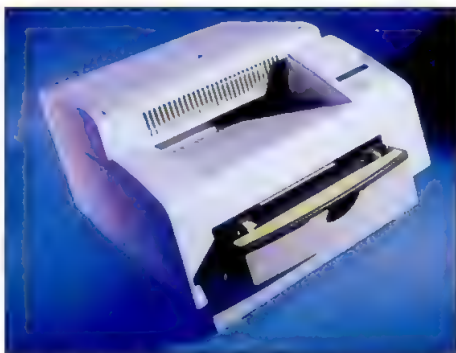
Considering the price, it's

nice to see that the ColorEase PS doesn't cut any corners. Standard features include 16MB RAM; a 120MB internal hard disk; serial, parallel, and LocalTalk ports; and two SCSI ports. The review unit was also equipped with an EtherTalk port, a \$495 option.

WORKHORSE MEMORY

The printer can accept input simultaneously from all ports, and will assign memory to each print job on the fly, using the 16MB RAM plus 70MB on the hard disk as virtual RAM. Most of the remaining disk space is filled by Adobe Level 2 PostScript and the standard set of 35 fonts. Roughly 3MB is left over for downloading fonts.

With its 40-MHz RISC processor, the controller is actually a Sun SPARCstation. To speed multiple print jobs, the controller can accept and process one print job even while printing another. Kodak's proprietary A-size engine prints at 300 dpi and 3.5 minutes per page; both those statistics are typical for the technology. The maximum image size is 8 by 8.9



BARGAIN: The ColorEase costs \$2,000 less than its competitors.

inches on 8.5- by 11-inch paper.

In PC Magazine Labs' performance tests, the ColorEase

FACT FILE

Kodak ColorEase PS Printer

Eastman Kodak Co., Desktop Imaging, Rochester, NY
14653; 800-344-0006,
716-724-5393

List price: \$7,999 with 16MB RAM; 120MB internal hard disk; parallel, serial, LocalTalk ports; a SCSI port for external hard disk; 20 sheets paper; 10 transparencies, one 30-print ribbon.

In short: At \$7,999, the ColorEase PS Printer is the least expensive, full function thermal dye transfer printer currently available. More importantly, you don't give up anything to save money. Far from it: In print quality, speed, and other features, the printer measures up to its more expensive competition.

 ON READER SERVICE CARD

PS Printer handled thin lines far better than two of the three thermal dye transfer printers we evaluated last year (November 24, 1992), and it was only a little behind the best.

Monochrome graphics and color output also manage a close second or better, with vibrant



LIKE A PHOTO: Cost per page is expensive, but the results are great.

colors and continuous tones. Transparencies offer fully saturated colors that will easily sur-

vive projection. The only noteworthy flaw was a slight banding in the vertical gray-scale bar.

COLOR MODES

In truth, our standard tests, all run from DOS, don't show the printer off to its best advantage. The printer offers four color modes: PostScript Levels 1 and 2, and Kodak's own UltraColor and UltraColor Plus. The two UltraColor modes need a special driver, which Kodak provides for the Mac and for Windows 3.0 and 3.1.

Kodak also provides a chart showing which mode is best for what kind of file. For example, UltraColor Plus is best for presentation graphics or Photo-CDs, but UltraColor is preferred for scanned images or combinations of scanned images with presentation graphics. And PostScript Level 2 mode is best for matching output from other PostScript Level 2 printers.

The drivers also let you fine-tune the output, with choices for brightness and tint. A little experimentation in Windows 3.1 proved that the settings can improve output quality dramatically.

You won't want to make too many draft prints, though, because thermal dye transfer printers have a notoriously high cost per page. The three-color ribbons (cyan/ yellow/magenta) cost \$145 for a 100-image roll (\$1.45 per image). Add the

paper at 65 cents per sheet or transparencies at \$1.15 each, and the price comes to \$2.10 to \$2.60 per image.

Regardless of the price per image, however, the ColorEase PS Printer is an impressive package, from its brilliant color to its 86MB workhorse memory. And for any application that

doesn't require printing on standard weight paper, it's hard to outdo. □

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John Dvorak, *PC Magazine*, March 30, 1993

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Jerry Pournelle, *Byte*, April 1993

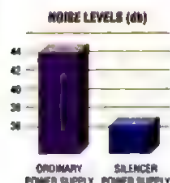
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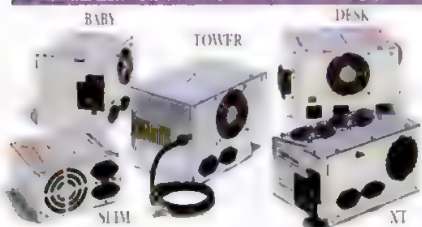
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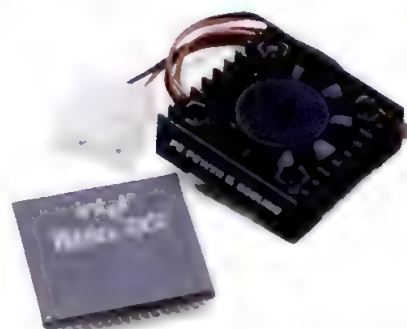
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Cooling Fan Capacity:	2	3	6
Filtered Air Inlet:	Yes	Yes	Yes
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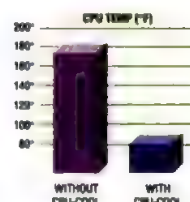
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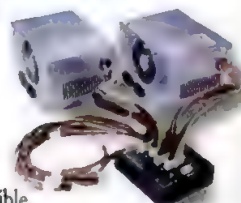
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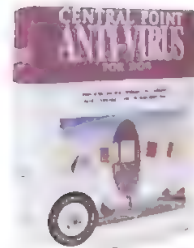
New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

IMPROVED

Central Point Anti-Virus 2.0 Is Expert in Detecting Viruses



Central Point Software has added an expert system to its DOS-based Central Point Anti-Virus 2.0 (CPAV) for detecting unknown viruses. The Virus Analyzer compares files it analyzes against what it knows

about viral code characteristics to make a positive ID. No prior data about files in uninfected states is necessary. CPAV now detects more than 2,000 known viruses, and scans compressed disk drives as well as files compressed in PKZip, PKLite, LZEXE, and ARJ formats. Central Point is also shipping Version 1.1 of CPAV for NetWare with increased performance and more capabilities.

- List price: *Central Point Anti-Virus, Version 2.0*, \$129.95 (upgrade \$29.95); *Central Point Anti-Virus for NetWare, Version 1.1*, \$1,199 (upgrade \$399). **Central Point Software Inc.**, 15220 NW Greenbrier Pkwy., #150, Beaverton, OR 97006; 800-964-6896, 503-690-8088; fax, 503-690-8083.

Circle 406 on reader service card

NEW

Fax from Your PC...in Color!

Black Ice Software has introduced the ability to fax in color to PC-based faxing programs. ColorFax for Windows (sold by ColorFax Sales & Marketing) is similar to other fax packages, but can fax images with up to 16 colors. For the color faxing to work, however, both PCs must be running ColorFax. If you know your recipient doesn't have ColorFax or you're faxing to a regular fax machine, you can force it to fax in black and white, thereby cancelling out the four-color separation process that would otherwise produce four pages of the same fax in black and white.

- List price: *ColorFax for Windows*, \$99. **ColorFax Sales & Marketing**, 23301 Ridge Route, #105, Laguna Hills, CA 92653; 714-454-9898; fax, 714-454-2960.

Circle 407 on reader service card

HOT PROSPECT

Raindrop Software Takes Workgroup Scheduling Forward

Raindrop Software Corp. has brought Object Linking and Embedding (OLE) to personal and workgroup scheduling with its new Windows-based Epoch, Version 1.0. Time will tell how users put this feature to work for them, but Raindrop Software is hoping that OLE will improve productivity by associ-



ating documents with scheduled activities. If you schedule a meeting you can associate a document to the event, and attendees can review the document in preparation. Epoch also supports OLE as a server application.

Epoch uses drag-and-drop to make scheduling easier and offers true conflict resolution. You can detect or display a conflict, but you can't manually resolve it unless you're authorized. In the event of a conflict, Epoch simply asks if you'd like to reschedule and then searches for the first time all attendees and resources are available.

Epoch works with NetWare, Windows for Workgroups, and other Windows-compatible networks. It uses the MAPI (Messaging Application Programming Interface) protocol to work with Microsoft Mail and other MAPI-compatible electronic mail programs.

- List price: *Epoch, Version 1.0*, \$129; \$895 for ten users. **Raindrop Software Corp.**, 833 Arapaho Rd., #104, Richardson, TX 75081; 214-234-2611; fax, 214-234-2674.

Circle 405 on reader service card

NEW

Canon's Bubble Jet Family Welcomes Newest Addition

The newest Bubble Jet Printer from **Canon Computer Systems** is the BJ-230, a 360-dot-per-inch printer that supports 11- by 17-inch paper and prints up to 30 percent faster under Microsoft Windows than the BJ-200 model printer. The BJ-230 maintains a small footprint of 7.9 by 16.9 by 8.2 inches (HWD) and weighs just 7.7 pounds. It prints at up to 248 characters per second on a variety of paper types, including envelopes, and also on transparencies. The unit comes with seven resident fonts and a replaceable head/ink cartridge (replacements cost \$25). It has an automatic sheet feeder that handles up to 100 sheets of letter or legal paper and up to 50 sheets of 11- by 17-inch paper.

- List price: *Canon Bubble Jet Printer BJ-230*, \$549. **Canon Computer Systems Inc.**, 123 E. Paularino Ave., P.O. Box 5048, Costa Mesa, CA 92628-5048; 800-848-4123, 714-438-3000; fax, 714-438-3099.

Circle 408 on reader service card

NEW

Alpha Software: Unlikeliest New Presentation Graphics Vendor

Presentation graphics seems a far cry from database management, but **Alpha Software Corp.**, maker of Alpha Four, has acquired its own Windows-based presentation graphics program and is pitting it against the likes of Harvard Graphics and Lotus Freelance. Alpha's new Bravo! focuses on ease of use at a low price (\$79), with features such as Smart Datapictures—a series of graphics that automatically change as you manipulate your presentation. Bravo! supports DDE and OLE, as well as 16 million colors. Objects defined in Bravo! can be moved, rotated, stretched, or even grouped with other objects so that relationships are maintained as you work.

- List price: *Bravo!, Version 1.0*, \$79. **Alpha Software Corp.**, 168 Middlesex Tpke., Burlington, MA 01803; 800-336-6644, 617-229-2924; fax, 617-272-4876.

Circle 409 on reader service card

IMPROVED

Fastback-up Your Drives Under DOS, Windows, and OS/2



Fifth Generation Systems has announced backup solutions to cover all the mainstream PC platforms, including Fastback Plus for OS/2, which takes advantage of OS/2's multitasking and scripting abilities and is cross-

compatible with the DOS and Windows versions of Fastback Plus. Fastback Plus 1.1 for Windows now includes a customizable toolbar and supports drag-and-drop and DDE.

Fifth Generation gives entry-level DOS users a boost with Version 2.0 of Fastback Express for DOS, which also has an improved interface and help system, a menuing system that makes it easier to choose files to back up, and a virus scanner to ensure a clean backup.

• List price: *Fastback Plus for OS/2*, \$199; *Fastback Plus for Windows, Version 1.1*, \$149; *Fastback Express for DOS, Version 2.0*, \$59. **Fifth Generation Systems Inc.**, 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-873-4384, 504-291-7221; fax, 504-295-3268.

Circle 412 on reader service card

NEW

Xerox's New Windows OCR Package Costs Just \$99

Xerox Imaging Systems has added new technologies to its Windows-based optical character recognition (OCR) software, TextBridge, and brought the package into the market at a user-friendly price of \$99. TextBridge incorporates the Lexifier, a technology that intelligently identifies known patterns or classes of data, such as social security numbers and postal codes so that, for instance, when it identifies a ZIP code, it knows that it could contain the numeral 0, but not the letter O. In addition, Xerox has improved the automatic segmentation process by which TextBridge processes compound and complex documents. It also supports Dynamic Data Exchange (DDE) and includes a macro for scanning directly into Microsoft Word.

• List price: *TextBridge*, \$99. **Xerox Imaging Systems Inc.**, 9 Centennial Dr., Peabody, MA 01960; 800-248-6550; 508-977-2000; fax, 508-977-5307.

Circle 411 on reader service card

BRIEFS

NOTEBOOK PCs

From **Altima Systems** comes the Altima 433 Color Notebook (\$4,999), based on an Intel 33-MHz 486DX processor and featuring an 8.5-inch active-matrix color display. It comes with 4MB of RAM, a 200MB hard disk, an internal 3.5-inch floppy disk drive, and a nickel hydride battery pack providing up to 2 hours of battery life. 510-356-5600

Altura Computer Systems is offering the ALT66C Powerhouse Notebook Computer (\$5,995) with an Intel 66-MHz 486DX2 processor, an 8.7-inch active-matrix color display, a trackball, 8MB of RAM, and a 540MB hard disk. The nickel cadmium battery last 2 hours. 719-685-5502.

To go with its new (and old) LTE Lite notebooks, **Compaq Computer Corp.** has introduced the Enhanced QuickConnect Option (\$299), which provides a low-cost alternative to a docking station. The 1.6-pound add-on is a plug-and-play solution that lets LTE Lite users connect to up to ten peripheral devices, including Ethernet networks and SCSI devices. 800-345-1518, 713-370-0670.

CUBE Computer Corp. is shipping two more affordable notebook PCs; the AMD 25-MHz Am386SXL-based CUBE ProBook 325NTX and the Cyrix 25-MHz 486SLC-based CUBE ProBook 425NTX (\$1,595 and \$1,795, respectively). Both have 4MB of RAM, an 80MB hard disk, a 9.6-inch backlit monochrome LCD, a built-in trackball, and an internal fax/data modem. The ProBooks are built for CUBE by Lexmark International. 800-522-2823, 914-592-8282.

Dauphin Technology is finally shipping what it calls "The World's Smallest 486," the Dauphin DTR-1 (\$2,495), a 2.5-pound subnotebook based on a 25-MHz 486SLC processor. The DTR-1 accepts pen input and runs Windows for Pen Computing. It comes with a built-in fax modem and an IDE port that supports an external floppy drive. The Kittyhawk hard disk can hold up to 80MB with data compression. 800-782-7922, 708-971-3400.

IMPROVED

Epson Puts the Muzzle on, Lights Fire Under Printers

"Quiet" is the word on the lips of every dot matrix printer vendor these days, and **Epson America** is no exception. Epson has sped up and quieted down its 24-pin Action Printer 5000+ and LQ-570+ printers to deliver up to 337 characters per second at a noise level of 46.5 decibels. The paper handling abilities of both printers include automatic loading for single sheets and continuous forms; top, rear, bottom, and front paper feed paths; and a convertible push/pull tractor for precision forms handling. Each printer has four scalable and ten bit-mapped fonts. To enable the printers to produce higher-quality text and graphics, Epson is offering a free Ultra Letter Quality Film Ribbon with every printer.



Action Printer 5000+: Epson's quiet dot matrix.

• List price: *Epson Action Printer 5000+*, \$349; *Epson LQ-570+*, \$349. **Epson America Inc.**, 20770 Madrona Ave., Torrance, CA 90509-2842; 800-922-8911, 310-782-0770; fax, 310-782-4235.

Circle 410 on reader service card

NEW

U.S. Robotics' Modems Are Now the Size of a Credit Card

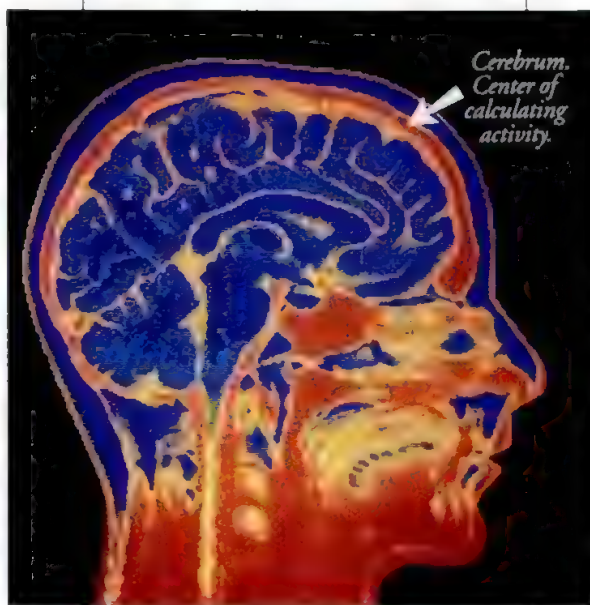
The market for PCMCIA-based peripherals is expected to grow dramatically over the next few years, and **U.S. Robotics** is staking its claim with two high-speed fax/data modems and a dual standard modem with V.32bis and cellular capabilities, plus the vendor's own HST 16,800-bps asymmetrical data transmission protocol. The WorldPort 14,400 Fax/Data PCMCIA, Version 2.0, has CCITT V.17/14,400-bps fax and CCITT V.32bis/14,400-bps data capability, while its sibling, the WorldPort 2496 Fax/Data PCMCIA, Version 2.0, has 9,600-bps Group III fax and CCITT V.22bis/2,400-bps data capability. The WorldPort Dual Standard

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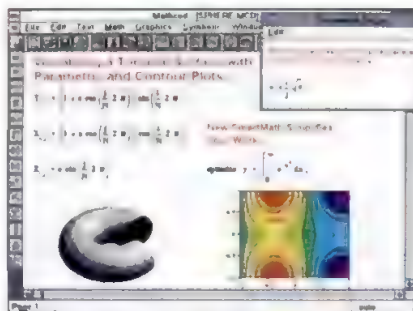
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modem has the same capabilities as the WorldPort 14,400, but also features an HST Cellular, U.S. Robotics new protocol for cellular data transmission that has been tested to achieve



The WorldPort 14,400 Fax/Data PCMCIA card.

approximately 8,000 bps in a moving vehicle and approximately 12,000 bps when standing still. U.S. Robotics' Smart DAA (data Access Arrangement) technology is included in all the PCMCIA products.

• List price: *WorldPort 14,400 Fax/-*

Data PCMCIA, Version 2.0, \$649; WorldPort 2496 Fax/Data PCMCIA, Version 2.0, \$349; WorldPort Dual Standard, (pricing not available at press time). U.S. Robotics Inc., 8100 N. McCormick Blvd., Skokie, IL 60076; 800-342-5877, 708-982-5010; fax, 708-982-5235.

Circle 413 on reader service card

NEW

Tandy's New Personal Digital Assistant Arrives

The day of the personal digital assistant is dawning, and **Tandy Corp.** is basking in the first rays with its new Tandy Z-550 Zoomer. The Zoomer weighs under a pound and operates up to 100 hours on three AA batteries. It includes an address book, bank book, date book, calculator, dictionary, language translator, personal finance manager, thesaurus, and more, including three games, U.S. city and state information, and a nutrition guide. You use a stylus to either write in information or tap an on-screen keyboard.

An optional modem can connect you to America Online, and built-in infrared transceivers give you wireless communication. A serial port lets you transfer data to a desktop PC. The 1- by 4.2- by 6.8-inch (HWD) Zoomer is based on a special Intel-compatible chip and has a PCMCIA Type 2 slot. It has an object-oriented, multithreaded, multitasking operating system with a graphical user interface provided by GeoWorks. The operating system consumes 640K of the 1MB of system RAM; 4MB of system ROM physically holds the operating system, the applications, and any data you input. It will be sold through Radio Shack stores and dealers nationwide.

• List price: *Tandy Z-550 Zoomer PDA, \$699. Tandy Corp., One Tandy Center, Fort Worth, TX 76102; 817-390-3200.*

Circle 414 on reader service card

BRIEFS

NOTEBOOK PCs

The new Keynote Force (\$1,995) from **Keydata International** is a user-upgradable notebook PC based on Intel's 33-MHz 486DX processor. The 120MB hard disk can be switched to a 200MB or 340MB drive, a 50-MHz 486DX processor can be installed, and the 10-inch monochrome display can be replaced with an 8.5-inch active-matrix color display. The floppy disk drive slot also serves as a port for a PCMCIA 2 chassis. The 5.7-pound Keynote Force comes with a TrackMan Portable Mouse and a nickel cadmium battery rated to last 2.5 hours. 800-486-4800, 908-755-0350.

NCR Corp.'s new NCR 3150 notebooks (\$1,925 to \$3,805) have user-upgradable batteries (nickel cadmium to nickel hydride), displays (mono to double-scan color to active-matrix color), hard disks (80MB to 170MB), and memory (4MB to 20MB), plus a PCMCIA Type 2 slot and local bus video. The 25-MHz 486SX-based 3150s are the first to use NCR's new optional WaveLAN/PCMCIA cards for wireless networking. 800-225-5627, 513-445-5000.

PENTIUM PCs

Advanced Logic Research has announced the Evolution V-Q (under \$5,000), featuring a 60-MHz or 66-MHz Pentium processor and ALR's QuadFlex 128 architecture, which is optimized to take advantage of the Pentium processor. ALR has also announced a Pentium upgrade module (\$2,395) for its ProVEISA line of PCs, and the Evolution V series will be available with a 60-MHz Pentium (starting at \$3,095 with a hard disk). 800-444-4257, 714-581-6770.

AST Research's announced Pentium products include the Premium SE P/60 Server (\$7,500 to \$9,500) will use AST's Cupid processor design for 64-bit performance at 60 MHz. The Manhattan SMP Symmetric Multiprocessor (\$32,000 to \$36,000) is Pentium-ready and is currently available with 50-MHz 486DX processors. The Premia P/60 Desktop (\$5,500 to \$8,000) is an EISA-based system which can accommodate a Pentium by way of an upgrade board. 800-876-4278, 714-727-4141.

NEW

A Photo Album Is Portable, Now So Is Kodak's Photo CD

With **Eastman Kodak's** recently announced Kodak Photo CD Portable Player PCD 970, you can listen to CDs while traveling, then show off your latest 35-mm photos when you get where you're going. The Portable Player looks like any other sleek portable CD player and comes with stereo headphones and a remote control. Its advanced viewing controls come straight from Kodak's deck players and include Tele, which lets you select part of an image and enlarge it, and Insert, which lets you view pictures in any order. All Photo CD Disk formats are fully supported.

• List price: *Kodak Photo CD Portable Player PCD 970, \$449. Eastman Kodak Co., 343 State St., Rochester, NY 14650; 800-242-2424, ext. 77, 716-724-4000.*

Circle 416 on reader service card

NEW

Where Flying Toasters Stop, More After Dark Begins

Berkeley Systems has announced an add-on to its After Dark screen-saver program. More After Dark for Windows (M.A.D.) has over 25 new screen savers complete with sound, including Fractal Forest, which uses fractal geometry to create tree shapes; and Origami, which simulates the Japanese art of paper folding. M.A.D. requires After Dark for Windows 2.0 or Star Trek: The Screen Saver.



With the Disney Screen Saver you'll feel like a kid again at your PC.

Also from Berkeley is The Disney Screen Saver, which gathers such personalities as Mickey Mouse, Donald Duck, Goofy, Pinocchio, and even the Little Mermaid for a reunion on your hard disk, with quality animation and sound.



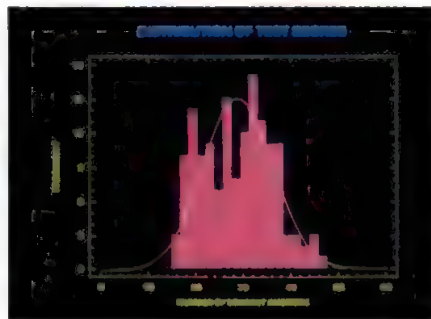
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New & Improved

• List price: *More After Dark for Windows*, \$39.95; *The Disney Screen Saver*, \$59.95. Berkeley Systems Inc., 2095 Rose St., Berkeley, CA 94709; 800-877-5535, 510-540-5535; fax, 510-540-5115.

Circle 415 on reader service card

NEW

Compaq's Deskpro Line Adds Two Pentium Models

Compaq Computer Corp. has announced two new Deskpro/M systems based on Intel's Pentium processor. The Deskpro 5/60M and Deskpro 5/66M are optimized to take advantage of the new chip's power with a 128-bit memory bus, a 64-bit processor bus, and a 32-bit EISA I/O bus. This TriFlex PC Architecture has a controller that manages the data flow between buses, letting two buses exchange data without affecting the third. The two systems also come with the new 1,280-by-1,024 Compaq QVision 1280 controller with 2MB of VRAM, providing 256 colors at 1,280-by-1,024 resolution. For a look at who else has announced Pentium-based PCs, see the Briefs section.

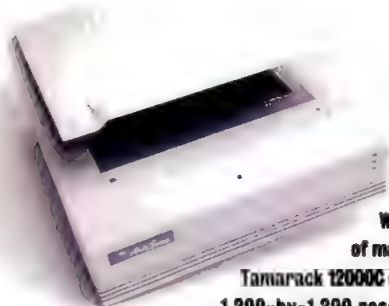
• List price: *Compaq Deskpro 5/60M and Compaq Deskpro 5/66M*, starting around \$4,999. **Compaq Computer Corp.**, P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; fax, 713-378-1443.

Circle 419 on reader service card

NEW

Tamarack Ships 1,200-Dpi Scanner for Under \$2,000

Tamarack Technologies is shipping a 1200-dpi, 24-bit color flatbed scanner, the Tamarack 12000C. The 12000C supports an actual resolution of 1,200 by 600 dpi, but using electronic interpolation built into the hardware, the resolution increases to 1,200 by 1,200 dpi. The 8.5- by 11.75-inch scanning surface sup-



With a bit of magic, the Tamarack 12000C delivers 1,200-by-1,200 resolution.

BRIEFS

PENTIUM PCs

In addition to its new Deskpro/M systems, **Compaq Computer Corp.** has announced that the Systempro/XL 5/66 server (starts at \$17,999) will have a 66-MHz Pentium chip and Compaq's TriFlex/Systems Architecture, which is optimized for the processor. The ProSignia 5/60 server (\$6,299) will have a 60-MHz chip. 800-345-1518, 713-370-0670.

Hewlett-Packard Co. has announced that its HP Vectra line will include Pentium-based systems. Pricing is not yet available and the PCs won't ship until fall, but it is quite likely that these units will be exciting considering the enhancements to HP's current line, including on-board, integrated networking abilities; serial infrared communications; and PCMCIA expansion slots. Current HP Vectra systems range in price from \$1,169 to \$3,749. 800-752-0900

NCR Corp. has unveiled its plans for the NCR 3360 (\$18,000 to \$20,000), a Pentium-based dual-processor workstation with a CD-ROM drive and an Ethernet or Token-Ring adapter. NCR has also announced plans to produce four other Pentium servers, the NCR 3430, 3455, 3525, and 3555, as well as Pentium upgrade boards for the NCR 3450 and 3550. 800-225-5627, 513-445-5000

NEC Technologies has introduced the NEC Image P60 with 60-MHz Pentium processor and Intel's PCI local bus architecture. The memory bus interface is natively 64-bit and has a burst mode secondary cache. The PCI local bus video subsystem comes with 2MB of VRAM. Pricing is not yet available. 800-388-8888, 508-264-8000.

The PW² Advantage Plus 5606 and 5608 and the U 6000 Unix server are scheduled to be the first Pentium-based offerings to come from **Unisys Corp.** The vendor has also announced that a Unisys Pentium Upgrade Kit will be available for current PW² Advantage Plus 4666 and 4668 systems. Pricing is not yet available. 800-448-1424, 215-986-4011.

ports slides, X-ray film, and full-size transparencies using an optional \$795 slide kit, and the scanner itself has hardware gamma correction and 200 adjustable levels of brightness and contrast. It's a reasonably compact desktop scanner, measuring 4.8 by 13.1 by 18.5 inches and weighing 17.7 pounds, and it can automatically switch the input voltage between 90 volts and 260 volts. The 12000C comes with a SCSI interface card and Aldus PhotoStyler image processing software.

• List price: *Tamarack 12000C*, \$1,995. **Tamarack Technologies Inc.**, 1544 Centre Pointe Dr., Milpitas, CA 95035; 800-643-0666, 408-956-0144; fax, 408-956-1552.

Circle 417 on reader service card

IMPROVED

Save Power and Money When You Remote Control Your PC



Remote Power On/Off • AUX turns on your system when you dial in, and manages a single phone line.

If you use remote-control software but feel guilty about leaving your host PC on 24 hours a day, **Server Technology's** Remote Power On/Off+AUX is the answer. In Remote Power Switch Mode, the PC simply powers on after a certain number of rings and automatically powers off when you hang up. In AUX Port Mode, the home or office with a single phone line can share a PC's

modem with an answering or fax machine. Calls pass through the answering or fax machine and access to the modem is controlled by communications software. In Reboot Mode you can reboot a locked-up workstation or server as if you were at the power switch.

User-definable features include the ability to set the number of rings before the host PC turns on, and the ability to determine the length of time, after the modem hangs up, before the host PC is turned off—ideal if you use a comm package that permits the host to dial back to the PC that places the call.

• List price: *Remote Power On/Off+AUX*, \$169.95. **Server Technology Inc.**, 2332-B Walsh Ave., Santa Clara, CA 95051; 800-835-1515, 408-988-0142; fax, 408-988-0992.

Circle 418 on reader service card

If managing
your server
eats up all
your time,
you need an
assistant.

Introducing the new HP

We're introducing more than just two new servers. We're introducing a profound improvement in the way you monitor and manage your servers.

Continuous Assistance.

We've put server management right where it belongs. At your fingertips. The HP NetServer Assistant software lets you easily monitor and manage your network servers from a single console—either locally or remotely. So your server stays up and running. Not you.

What's more, you can quickly diagnose and solve problems with its intuitive interface and troubleshooting tools. And the

HP Support Assistant, a CD-ROM-based library, is included to provide lots of valuable technical information.

Maximum Uptime.

These new HP NetServers lead the pack in reliability. RAID-based disk arrays on the LM provide advanced fault tolerance. And, thanks to our hot-swap capabilities, you can now replace an internal drive without bringing the server—or your network—down. The array will also automatically rebuild data on a failed drive. And for maximum protection, the LM even supports Error Correcting Code memory. In fact, the more critical your data, the more critical these servers become.

Investment Protection.

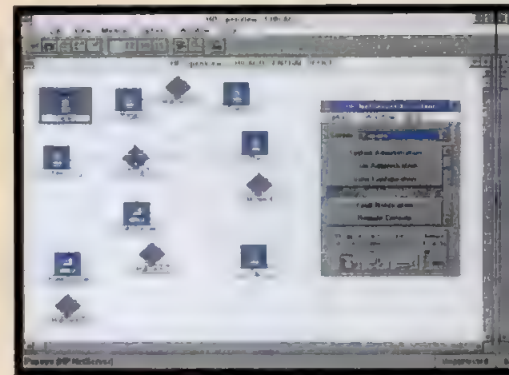
With technology changing faster than the

weather, you'll be happy to know that HP's NetServers are designed to keep pace. And keep your investment protected. Both the LE and LM fit smoothly into multi-vendor environments. The LE is the ideal entry-level server. Upgradable to the future Intel OverDrive Pentium™ technology-based processor, it provides affordability, exceptional serviceability and future scalability.

Built to meet the full demands of the Pentium processor, the LM will also support dual symmetric multiprocessing. Its Power Cabinet allows room for expansion with nine front-accessible mass storage shelves, eight expansion slots and maximum memory capacity of 384 MB.

HP Service and Network Expertise.

All this is backed by HP's complete range of support services. And by HP's 20+ years of network



HP NetServer Assistant

HP NetServer LM

NetServer LM and LE.

systems experience. You can choose support from HP directly, or from your local authorized HP dealer. HP NetServers come standard with a three-year, on-site limited warranty. And a host of 24-hour at-your-service support programs, such as our fax information retrieval service, automated phone support and electronic bulletin board service, ensure easy manageability around the clock.

If all this sounds good, call 1-800-964-1566.

We'll be happy to provide you with fast assistance. And, chances are, without the HP NetServer LM or LE, that's exactly what you need.



HP NetServer LM

\$4,849*

- 60-MHz Intel Pentium™ processor, 33-MHz Intel 486 DX and 66-MHz Intel 486 DX2 processors
- Support for dual Pentium symmetric multiprocessing
- High fault tolerance with internal RAID disk array option (RAID 0, 1, 5, 6)
- 16-MB standard RAM, 384-MB maximum memory, ECC memory support
- 128-KB and 256-KB external cache
- 9 mass storage shelves, 3.5" floppy disk drive standard, maximum 8-GB internal storage
- 8 EISA-2 with Enhanced Master Burst bus-master I/O slots
- Integrated Fast SCSI-2, IDE and video controllers
- HP NetServer Assistant software included
- 3-year on-site, next-business-day limited warranty
- Tested and certified on major network operating systems

HP NetServer LE

\$2,649**

- 33-MHz Intel 486 SX, 33-MHz Intel 486 DX and 66-MHz Intel 486 DX2 processors
- Upgradable to Intel OverDrive Pentium technology-based processor when available
- 4-MB and 8-MB standard RAM, 128-MB maximum memory
- 256-KB external cache
- 4 mass storage shelves, 3.5" floppy disk drive standard, maximum 3-GB internal storage
- 5 EISA bus-master I/O slots
- Integrated Fast SCSI-2, IDE and video controllers
- HP NetServer Assistant software available as an option
- 3-year on-site, next-business-day limited warranty
- Tested and certified on major network operating systems

HP NetServer Assistant

Easy-to-use centralized management based on HP OpenView's leading network management environment allowing multiple servers in multiple sites to be managed from a single graphical map.

Problem identification and resolution tools including diagnostics, configuration information (whether the network operating system is up or down), disk capacity planning and technical information via a CD-ROM-based library.

Remote management capabilities allow administrators to use the same tools whether at their local console or a remote PC.

Open architecture facilitates adding specialized third-party or HP management utilities.

* U.S. list price for HP NetServer LM Model 530, including 486/DX processor, 16-MB RAM and 545-MB SCSI hard drive. ** U.S. list price for HP NetServer LE Model 120, including 486/SX processor, 4-MB RAM and 4-MB 3.5" hard drive. Prices subject to change without notice. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. © 1993 Hewlett-Packard Company. PPG099

HP NetServer LE



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* AT&T patent pending

Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Take a Grand Tour Through Artificial Life

BY ALFRED POOR

One of these four items does not belong: a computer virus, Frankenstein's monster, a plan for a lunar robot factory, and a computer-simulated cockroach that can locate food. If you chose the monster, you're right. It's the only work of fiction in the list. The rest are from the real world and are related to the study of artificial life, or *a-life*.

The history of *a-life* research has been nimbly documented by Steven Levy in *Artificial Life: The Quest for a New Creation*. In a documentary style reminiscent of Tom Wolfe or Tracey Kidder, Levy weaves an engaging web of personalities, technology, and philosophy.

Artificial Life begins by anchoring the premise firmly on solid ground. The father of the modern computer, John von Neumann, laid the groundwork



for *a-life* research with his belief that biology is rooted in logic and that building a computer that can reproduce itself is possible. At the core of this concept is the assumption that all life is based on information coded in cellular DNA and RNA and that other conceivable forms of life could be based on other types of information. Von Neumann's theory also assumes that creating complex systems using fundamentally simple rules is possible.

Levy chronicles some fascinating experiments that explore these concepts. One of the earliest experiments was an artificial world created by John Conway at the University of Cambridge. It came to be known as a game called Life. Based on a simple set of rules that determine whether a cell on a grid lives or dies based on the status of neighboring cells, Life is a fertile environment for

modeling population fluctuations. The game later became a popular exercise for programmers, and you can still find programs that run Life simulations on PCs.

Another experiment used simple rules of attraction and separation to create flocks of birds in a computer simulation that produces complex behaviors that biologists identify as lifelike. Scientists also created programs that generate digital ant colonies that reproduce by swapping genetic material.

A-life has even been used to develop application code, from sort routines to more complex behaviors. But not all *a-life* exists within memory chips. Robots have been created that exhibit complex learned behav-

iors that started from simple rules and feedback systems.

All these examples demonstrate that life could well be a product of bottom-up design—a relatively small set of simple rules could be responsible for the incredible diversity of life and behavior.

Levy also takes a sober look at the future of *a-life* research. The problems we've seen with computer viruses only hint at the ethical issues we'll have to face when we manage to create an organism in a computer that is unquestionably alive.

• **Artificial Life: The Quest for a New Creation**, by Steven Levy, \$13 (paperback). Pantheon Books; 800-733-3000. ISBN: 0-679-74389-8.

Circle 459 on reader service card

A-Life Lab on Disk

BY ALFRED POOR

If you've caught the *a-life* bug from Stephen Levy's book and want hands-on experience with *a-life* experiments on your own PC, you'll enjoy *Artificial Life Playhouse*. Author Stephen Prata starts with an overview of *a-life* research, then documents the nine programs on the book's accompanying disk.

The wide range of experiments stretches from the one-dimensional cellular automaton used by Stephen Wolfram (inventor of Mathematica software) to two programs based on John Conway's Game of Life. You'll also get to explore simulations of genetic evolution—a modeled world of plants and animals, a modeled ant population, and a modeled

world of competing red and black ant populations. You can adjust parameters for genetic sharing and mutation rates and then watch as the behaviors and other traits evolve over generations.

There's even a program that shows how genetic mutation and cross-linking can produce a target goal faster than random combinations can. You enter a word then the

program guesses it by generating a random string of letters of the same length and adjusting it until there's a match.

It's real-life *a-life*. □

• **Artificial Life Playhouse: Evolution at Your Fingertips**, by Stephen Prata, \$23.95. Waite Group Press; 800-368-9369. ISBN: 1-878-73932-8.

Circle 460 on reader service card



Information as Primordial Soup

"There is a particular reluctance to concede the honor of life-form to anything created synthetically. This reluctance often transforms itself into profound skepticism, even mockery, when one suggests that life could be fashioned in a laboratory or in a computer, by using as the main substrate not organic molecules or other familiar forms of chemistry but something quite different—information.

"Information. The premise being that the basis of life is information, steeped in a dynamical system complex enough to reproduce and to bear offspring more complex than the parent. This was von Neumann's premise."

—*Artificial Life*, page 22.

The Ceramic Coated Particle Only From Maxell.

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ADMINISTRATION	1. Automated Directory Synchronization with built-in fault tolerance	☒	☐
	2. Capacity to synchronize across backbone of a foreign system	☒	☐
	3. Common gateway and server administration program	☒	☐
	4. Batch User Creation Facility	☒	☒
	5. Graphical Move User Facility	☒	☐
	6. Computer-based Training for new users	☒	☐
SCALABILITY	1. Circular route detection of mail messages	☒	☐
	2. Hop count tracking to detect routing errors across complex networks	☒	☐
	3. Multitasking MTA (message transfer agent)	☒	☒
	4. Wide Area Network (WAN) support	☒	☒
GATEWAYS	1. Backbone capacity through other mail systems	☒	☐
	2. Encapsulation to ensure message integrity	☒	☐
	3. Automated notification of gateway status	☒	☐
	4. Integrated X.400 MTA and gateway	☒	☐
	5. Fax directly from any Windows-based application	☒	☐
PLATFORMS	1. Client for Windows	☒	☒
	2. Client for MS-DOS	☒	☒
	3. Client for Macintosh	☒	☒
	4. Client for OS/2	☒	☒
	5. Client for UNIX*	☐	☒
	6. Remote client for MS-DOS	☒	☒
	7. Remote client for Windows	☒	☐
	8. Server for MS-DOS	☒	☒
	9. Server for Macintosh	☒	☐
	10. Multiplatform client software included in the server box	☒	☐



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That's how we see it. But as

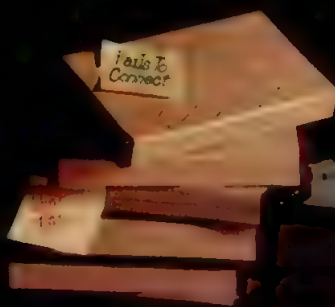
you can tell from the awards that Microsoft Mail has won, others

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CIRCLE 136 ON READER SERVICE CARD

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Trudy Neuhaus

Add Graphics Printing to DOS Apps—The Easy Way

BY SHERYL CANTER

It's extremely tedious for developers to provide printing services in DOS programs. For text printing, you can get away with learning a few basic escape sequences for each printer. But for graphics printing, you need to learn a substantial portion of each printer's command language. Luckily, there's an easy solution—if you're using a Borland C++ or Pascal compiler.

Unlike the graphics engines from other compiler vendors, Borland's is device independent. It uses drivers for device-specific information rather than hardcoding it within the compiler itself. Borland ships its compilers with drivers for screen graphics, which you can bind into your application's executable or provide as separate files. But Borland's graphics engine can be used for more than just video displays.

A few third-party vendors have used Borland's BGI Driver Toolkit to develop printer drivers for a variety of popular printers. Ryle Design and Fleming Software are two, with the BGI Printer Driver Toolkit (BGI PDT), Version 1.2, and Graf/Drive Plus, Version 3.0, respectively.

With these drivers and their utility libraries, printing graphics from within a DOS program is as easy as switching drivers. The same Borland graphics commands used to draw images on the screen can be used to

print them. There are two caveats: First, you must use stroked fonts rather than bitmapped fonts. Second, you must write your graphics routines in a device-independent way; if you hardcode values that correspond to screen images, the image won't scale properly when you print it.



DUELING DRIVERS

At \$129.95, BGI PDT costs significantly less than Graf/Drive Plus. Fleming Software charges \$299 for a developer's license, plus \$99 for the desktop publishing (DTP) drivers that let you write image files to disk. Graf/Drive Plus supports more printers, but BGI Printer Driver Toolkit comes with full source code; Fleming Software doesn't sell the source code.

Both toolkits support the most popular printers on the market (Epson and IBM dot matrix printers, and Hewlett-Packard LaserJet printers and plotters), but Graf/Drive Plus supports many others as well. Both vendors also supply at least one driver for writing graphics files to disk in the same way that a driver would be used to write to the screen or printer. One advantage to this is that you can create disk images of screens at a higher resolution than you can using screen capture software. Graf/Drive Plus DTP supports numerous graphics file formats (such as GEM, .IMG, .PCX, TIFF, Windows 3.x .BMP, and WordPerfect WPG), but the .PCX driver sup-

ports only 16 colors and uses a fixed palette. BGI PDT lets you write only .PCX files, but it supports 256 colors and you can specify the palette.

Each toolkit provides different ways of passing printer or image file settings to the driver. With Graf/Drive Plus you put your settings in a global, static structure at the top of your source file; BGI PDT uses function calls. While the structure approach is cleaner, it removes your settings from the general area of your printing code.

The method each uses to initiate graphics mode is different, too. BGI PDT uses the standard Borland `initgraph()` and `closegraph()` functions for entering and leaving graphics mode, so it's theoretically possible to print graphics by changing only the driver and not a single line of code. The additional information needed to print or create the image files is communicated to the driver through function calls. Graf/Drive Plus replaces the Borland functions with proprietary versions containing extra parameters.

BGI PDT and Graf/Drive Plus each provide a hook for user-defined functions to receive passed information about printing progress. For BGI PDT, the passed parameters take on different meanings depending on which function within the driver is calling it. With Graf/Drive Plus, the user function is only called as the image is printing. This is simpler, but there is a slight delay before you can gain control over the process. In addition, error messages are not returned to the user function; you must call a

dedicated function after printing and test the return value.

Scaling fonts is always a problem when shifting to a printer. Graf/Drive Plus provides a replacement for Borland's `settextstyle()` function that lets you set both the height and width in a variety of units. This works, but it requires trial and error to find the correct parameters. And a calculation error in the function causes the left sides of each letter to appear somewhat flattened.

BGI PDT doesn't have a much better solution. Font sizes can be scaled up with `bgi_fontsize()`, but they don't scale correctly and strings will often be too wide. To solve this, Ryle Design provides the `bgi_string_squish()` function, which lets

you set a maximum string width and narrows letters to fit.

Both the toolkits solve the problems of printing graphics under DOS, but BGI Printer Driver Toolkit costs significantly less and comes with

source code. So unless you need the additional drivers provided with Graf/Drive Plus, BGI PDT is a better buy. □

• BGI Printer Driver Toolkit, Version 1.2

List price: \$129.95. Requires: Borland C++ or Pascal compiler. Ryle Design, P.O. Box 22, Mt. Pleasant, MI 48804; 517-773-0587.

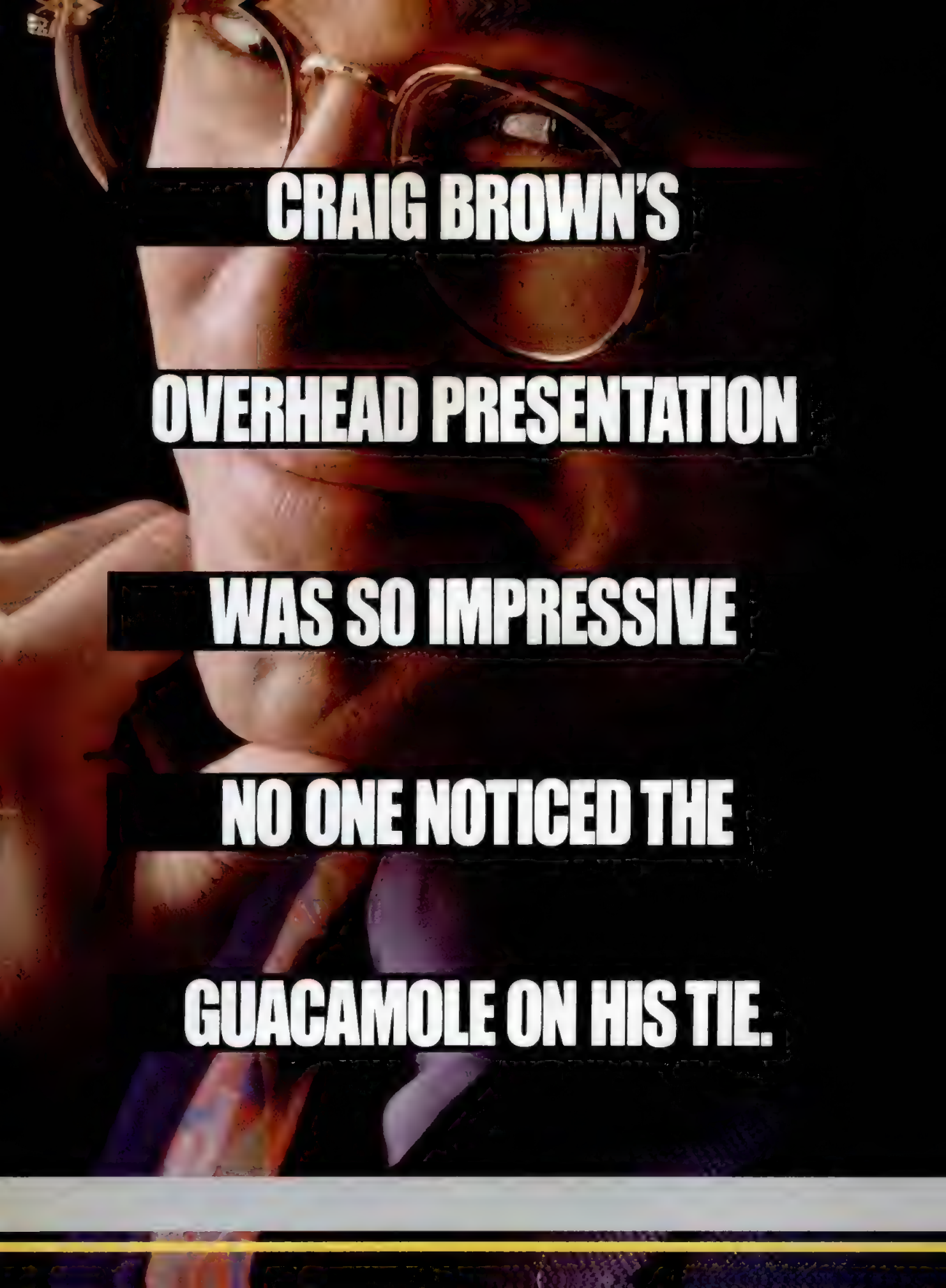
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• Graf/Drive Plus, Version 3.0

List price: \$299 (developer's license), \$149 (personal license), \$99 for DTP Driver Disk. Requires: Borland C++ or Pascal compiler. Fleming Software, P.O. Box 569, Oakton, VA 22124; 703-591-6451.

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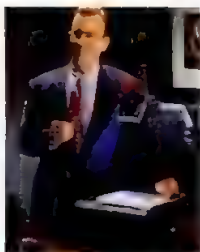
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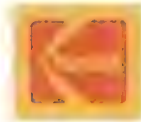
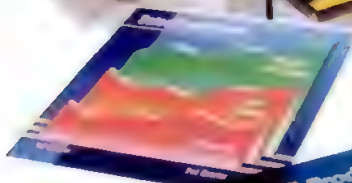
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Michael J. Miller

The Right Tool for the Job

Recently, I've noticed that when people ask me for buying advice, two questions always seem to get asked together: "Which portable computer should I get?" and "What software should I get for my portable to organize my work?" These

questions come as a pair because the portable computer—in tandem with some kind of information manager—is on the verge of replacing the venerable paper organizer that many of us carry today.

A couple of things are leading us in this direction: Portable computers are getting smaller and faster. Battery life is getting longer. Perhaps more important, the software available for managing your time, contacts, and schedule is getting better and better.

Deciding what to buy is complicated, however. Of course, there is no such thing as a Perfect Portable that is right for everyone. Some people want to run mainly time and contact management software. They may be looking for the optimal trade-off between weight and battery life. Some people want to use their portables mainly for electronic mail. Long battery life and a good modem are essential in that application. Some want to use their portables to create and give presentations. They may want the best color screen, and perhaps sound and CD-ROM options as well. Some want to use their portables as replacements for desktop computers, running the standard suite of productivity applications. They may want color, docking stations, and large amounts of RAM and hard disk storage.

If anything, the range of choices is even larger when it comes to software to manage your time, schedule, and appointments. Depending upon what individuals are looking for, I recommend a variety of packages.

• **Paper replacements.** If you are looking for a direct replacement for a paper system, Lotus Organizer is a great choice. This Windows-based program is incredibly simple to use. You enter names in an address book and appointments in a calendar, both

of which look remarkably similar to the paper-based systems you are probably already familiar with. At present, Organizer doesn't go much beyond the paper systems, but that may be enough for many people.

• **DOS companions.** If you don't have the horsepower for a Windows-based system and you want a good personal scheduler with an address book, there are two character-based DOS programs that strike me as the standouts. Borland's Sidekick is an oldie but a goodie. It gives you all the basics in a quick package, along with a few extras, such as the ability to coordinate appointments between two calendar versions. This feature can be crucial if you want an executive and an assistant to share a calendar. But the product is getting a little old. Chronologic Corp.'s Instant Recall has a good calendar and a particularly good address book that makes it easy to find the people and information you are looking for. Campbell Service's OnTime (for DOS and Windows) also follows in the same vein, but this package adds support for network scheduling and some wireless communications options.

• **OS/2 choice.** If you're an OS/2 user, the best choice may be Sundial Systems' Relish, a very graphical, very easy-to-use time manager. It also does a good job in taking advantage of OS/2's Workplace Shell and System Object Model by letting you drag and drop appointments to a printer or modem icon.

• **Contact managers.** Some people worry mainly about keeping track of their customers, what they have promised these contacts, and how and when they are supposed to follow up with them. If that description fits you, then you should look for a dedicated contact manager, such as Contact Software International's ACT! or



There's no such thing as the Perfect Portable, and there's no such thing as the Perfect PIM.

Richmond Technologies & Software's Maximizer (both available for either DOS or Windows) or Elan Software Corp.'s GoldMine (DOS only). While these programs can hold your schedule, they focus on contact management. They give you options for tracking your complete history with your customers, suppliers, and other contacts. They also generate form letters. There's even a version of ACT! that runs on Hewlett-Packard Co.'s subpound Palm-tops. (For more on contact managers, see "Keeping in Touch," in this issue.)

• **Do-it-yourself PIMs.** If you're the kind of person who wants both time and contact management and who wants to customize the appearance and function of your information manager, Polaris Software's PackRat (Windows) is an obvious choice. This package can do just about anything, and it gives you a lot of control over how information appears. PackRat has been a bit complicated in the past, but a new version (5.0) promises to be considerably easier to use.

If set up properly, PackRat does a reasonable job of keeping track of your time so that you can bill it to customers. Other products good for managing billable hours are Biz*Base Gold 2.2 and Timeslips 5 (both currently on DOS).

Like PackRat, a new package called ECCO Professional from Arabesque Software is very powerful but can be complicated to use. This Windows-based program lets you set up various kinds of customized views to see its schedule, contact manager, and multiple outlines. Its sophisticated outliner lets you store information in multiple folders and multiple views. This package may be a bit much if all you want is simple time and contact management. But if you liked the capabilities of Lotus's Agenda or Symantec Corp.'s GrandView (older DOS-based products that are essentially out of circulation), ECCO may be the right choice for you.

Another product that is also very customizable is Jensen-Jones's Commence (for Windows). It has a unique "agent" feature that makes it easy to automate tasks.

• **For professional managers.** If your primary responsibility is to manage other people, the best choice I've seen is Avantos

Performance Systems' ManagePro (for Windows). In a simple presentation, it lets you easily keep track of the people and projects you worry about and the intermediate goals. You can use ManagePro for your personal schedule, although that's not the product's strong point; it's really designed for managing people. Used alone or in conjunction with a more traditional time and contact manager, this may be the right program for managers.

Again, there is no such thing as a time and contact manager that is right for everyone. The important thing is to understand how you want to use your computer, then pick the package that best fits your needs. If you've got to change the way you work to do things the way the program demands, then you've got the wrong one. For some people, that may mean pen and paper is the best technology after all. But for most of us, there are enough electronic choices out there today to please our tastes.

Portable computers and time and contact management software have both come a long way. In the not-too-distant future, personal information management may be the application that persuades many of us to carry tiny computers. □

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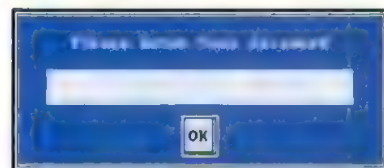
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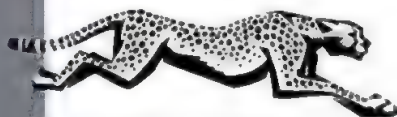
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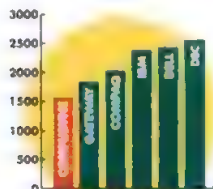
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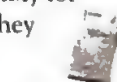
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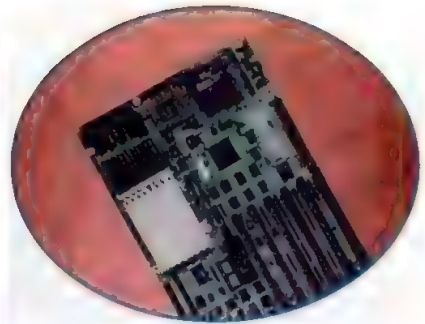
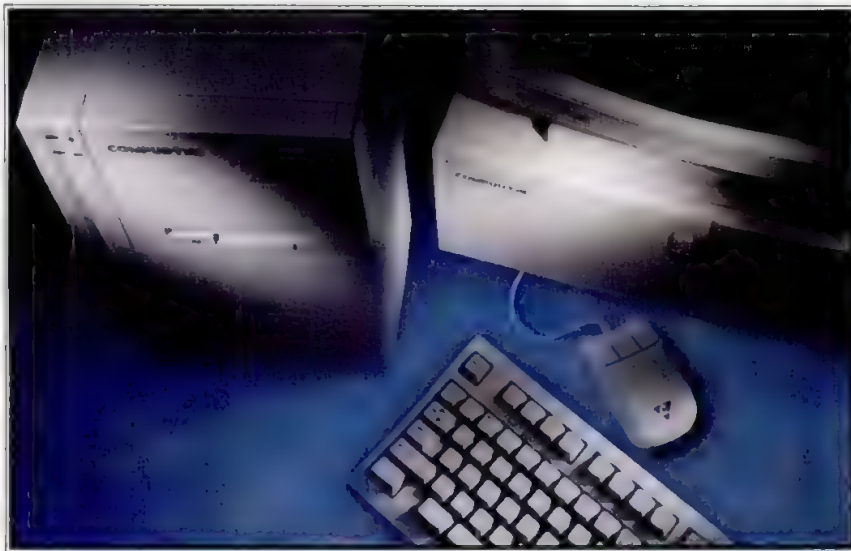
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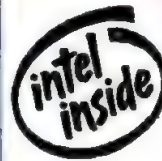
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Bill Machrone

Get Out of Jail

The question isn't whether you're in jail or not but how many jails you're in. There's installed-base jail, fax jail, Intel jail, Microsoft jail, and IBM jail, and that's just for starters. Escaping won't be easy, and it definitely won't be free.

Adobe's John Warnock got me thinking this way when he started talking about Adobe's Acrobat technology and its ability to get you out of ASCII jail. You're trapped in ASCII jail when you send messages across systems and are forced to the lowest common denominator—the ASCII character set and the resident or system font on the receiving system. Just as telephones don't cause our voices to sound alike, computers shouldn't force our correspondence to look alike—and look ugly. Acrobat frees you from ASCII jail by sending font information along with your document. Anyone who has used a GUI-based e-mail system knows that you can express yourself better with judicious use of emphasis, just as you do in spoken communication.

The effort to get out of a jail begins with the realization that you're in one. In the Acrobat case, if you're still bowled over by the miracle of sending messages across the wires, you're probably not a candidate for escape. If, instead, you rankle at the technical limitations, you're ready to break out. The supply and demand for typography as a means of expression are nearly limitless; my new copy of CorelDRAW 4.0 comes with a breathtaking 750 fonts.

Installed-base jail is one of the most insidious forms of incarceration. People willingly lock themselves up so they don't have to face the costs of staying at or moving to the state of the art. This is one case where you buy your way to freedom, and money is the only way to get there. People in installed-base jail are the most likely to protest that they've got everything they need. Meanwhile, they're losing competitive advantages at work and denying themselves digital entertainment at play. I'm not much of a fan of inden-

tured servitude to such a mean-spirited, low-performance master. The only problem is that staying out of installed-base jail is like paying taxes: You have to pay up regularly or you're right back in the slammer.

Fax machines are another kind of prison, only here it's your words that are held prisoner, immutable and uneditable on smelly, curly paper. Sure, plain-paper fax machines are making huge inroads on the old thermal designs, but the real problem is that faxed data is next to impossible to get into a computer except as an image. Yes, you can run character recognition software on the image and come up with an editable file, but who needs the hassle? Ironically, the material that was faxed to you probably originated on a computer anyway. Chances are that this PC was on a LAN and that your PC is connected to one, too. Unfortunately, there's no bridge that takes you across the electronic chasm.

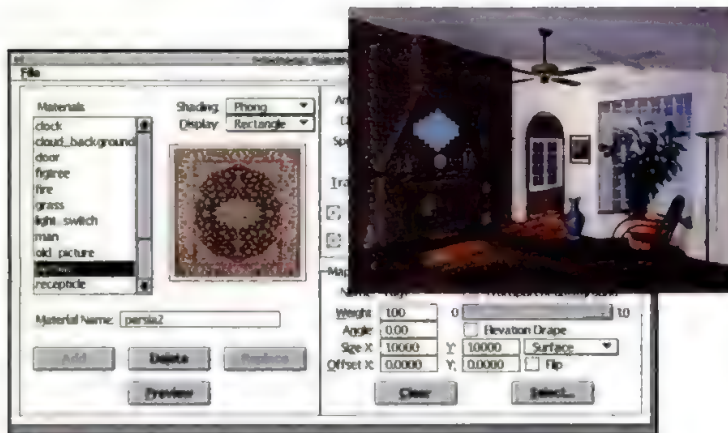
A lot of smart people are trying to get out of fax jail, and they're getting pretty close. The June announcement of Workplace Architecture by Intel, Microsoft, and others is a good example. It uses a new generation of network-connected fax machines as a

gateway from your system to mine. These machines will have the intelligence to recognize a computer-to-computer communication and will route the formatted, editable text to your desktop. Although these machines will be sold to businesses as super-duper fax machines, you're really building a dial-up wide area network.

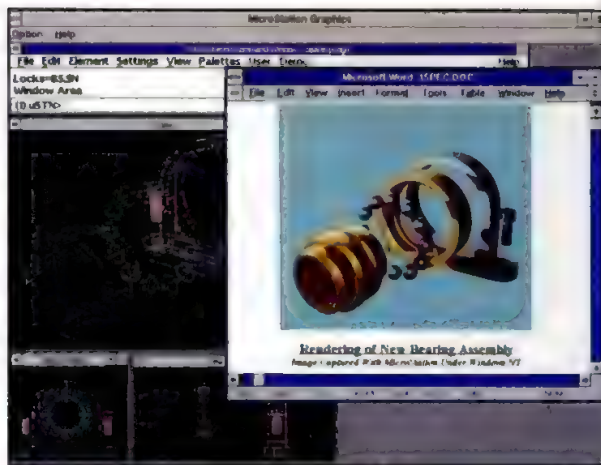
You'll have to wait another couple of months for real products, but this technology could get us out of e-mail gateway jail, too. Instead of going through all that X.400 junk, you'd just send a fax using the fax driver instead



Realizing you're in prison is the first step toward making the Great Escape. It won't be easy, and it won't be free.

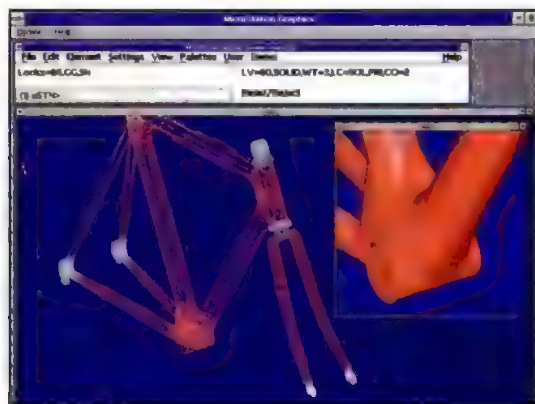


Rendering. Visualization and flytours – at your fingertips! MicroStation offers photo-realistic rendering to every designer, right in the software. It's easy to make your image reflect your imagination.



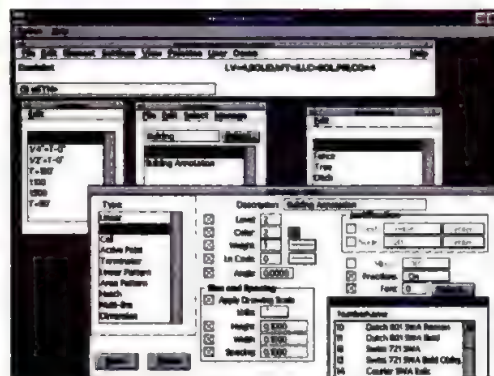
Windows. It walks and talks Windows. Behind MicroStation lies the user-responsive programming you look for in good Windows software. Version 5 gives you the ultimate in integration of CAD, engineering, and business applications.

MORE POWER TO YOU.



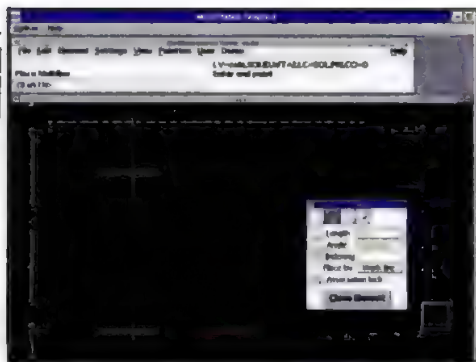
Modeling. Model any surface you can imagine in MicroStation. NURBS surface modeling combined with 3D Boolean operations gives you astounding flexibility in creating and modifying freeform models.

Read & write
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Workspaces. Choose the design environment that matches your profession or your CAD expertise – even AutoCAD. Complete with custom interfaces, drafting styles, and design environment management. CAD has never been so streamlined!

Drafting. MicroStation gives you first-rate drafting power – without the limitations of old technology. Enjoy the advantages of contemporary features like associative patterning/hatching, plot preview, standard text editing and fonts, and context-sensitive Hypertext help.



Usability. What does computer-aided drafting have to do with the way you think? Everything. MicroStation software works for you. It understands the drafting process so well that it infers what you'll do next.

Graphical User Interface.

MicroStation's easy-

to-use interface includes pull-down menus, dialog boxes, tear-

off tool palettes, and tool settings window. Choose your interface –

Windows or Motif – on any platform. **Transparent Modeless**

Operation. The software supports the way you naturally work, maintain-

ing command execution while you fine tune: change element attributes or com-

mand parameters, manipulate views, change the dimensioning system, and more. **Powerful View Manipulation.** MicroStation supports up to eight

active views that can be moved, sized, and overlapped to fit your design. Zoom and area at

any scale. Move around your design fast with built-in dynamic panning. **Workspace Editor.** Tailor pull-down menus, dialog boxes, and tool palettes –

even disable commands – with a graphically oriented toolset for customizing your chosen

interface. **Text Capabilities.** A convenient text editor lets you easily edit single-

line or paragraph text. Choose from TrueType, PostScript, AutoCAD SHX, and

MicroStation fonts. ASCII text files can be imported and exported. **Multiple**

Undo/Redo Commands. Undo mistakes and perform “what-if”

designs in a flash with unlimited undo and redo. **Plotting.** Plot raster and vec-

tor information by view or defined areas, at any scale. Visually preview the plot before

plotting, saving time and materials. **Online HELP.** MicroStation's

HELP remains active, tracking the command you're currently using,

so there's no searching through manuals for assistance. **Associative Patterning and Hatching.**

Associate patterning with graphics. Change graphics and the

patterning updates. Flood-fill hatching/patterning

intelligently fills an area, detecting boundaries

and holes with a single pick. **Associative**

Dimensioning. Dimensions are associated

with the geometry, not with a point in space, so that when you change the

geometry, the dimensions automatically update. **Custom Line Styles.** Create

space-saving custom line styles and place railroad tracks, trees, isobars – anything – just as you would place a line.

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Bill Machrone

of your local printer driver. The recipient's name and phone number would be enough to route the message.

OUT OF THE FRYING PAN

On the other hand, Workplace Architecture puts us more firmly in Microsoft jail, already a high-security institution. Frankly, it's a comfortable imprisonment, but the more comfortable we users are, the less comfortable the hardware vendors are.

Most of the standards engendered by Microsoft have the curious effect of creating or stabilizing a market, making it safe for buyers to come in. Hardware vendors design products around the software capabilities and they're off and running. The euphoria of a new market is quickly followed by rounds of price-cutting, competition, consolidation, and imploding profits. An old African proverb says that when the lion feeds, nobody in the jungle goes hungry. But you've got to make sure the lion is full, or you could wind up as dessert.

Microsoft tends to facilitate the transfer of technology among its inmates, whether they realize it or not. "We're thrilled and scared to death to be dealing with Microsoft," says one vendor's rep, who requested anonymity. He's afraid that his hard-won technology edge will be subsumed into a standard that gets distributed to other vendors. He gets the glory of recognition, but he's dismayed at the very real possibility of seeing others make more from his cleverness than he can.

BLUE JAIL

The original setting for the Great Escape in this industry was IBM jail. IBM started with 100 percent of the market; the only way from there was down. As open as the original PC standard was, it has always been replete with technological limitations. If you were going to be successful at selling PCs you had to work within the standards. But you could innovate in key areas. So in effect people have been breaking into IBM's jail in order to get a piece of the market share. In so doing, they usurped IBM's ability to set standards, as evidenced by local bus, EISA, and Super VGA, among other standards. They've forced IBM to break into its own jail in order to stay in the PC business.

Stone walls do not a prison make. Changing standards and new technologies are far more effective. □

PC/89

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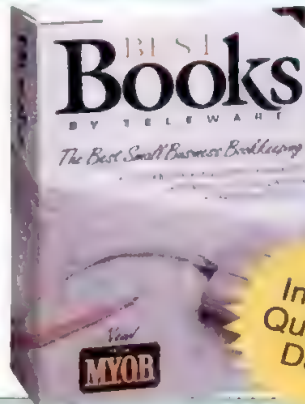
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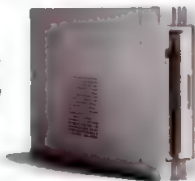


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John C. Dvorak

Will Windows Turn Proprietary?

Will Microsoft use court-upheld lockout techniques to prevent unauthorized use of its technologies? That's exactly what Nintendo and Sega did, and Microsoft could do it too. If Microsoft goes ahead and designs a Windows operating system

that requires special application I/O and runs only Microsoft-approved programs, then applications developers would either have to pay a license fee or be locked out of Windows altogether. Microsoft has a reputation for thinking along these lines. The book *Hard Drive* mentions a company ditty that goes, "DOS isn't done until Lotus won't run."

Once it establishes sole control of Windows, would Microsoft set up a licensing arrangement like the Nintendo gambit? Why not? It would look like a public service if handled right. "The licenses are to make sure the public gets only quality code written by approved vendors." Sounds good.

Notice how Microsoft officials have repeatedly emphasized that, according to contract, IBM will no longer have access to Windows code after September. This, to me, is a signal that Windows will become more closed than ever.

The way to avert this is by supporting something called Public Windows Interface (PWI). PWI was first proposed by Sun Microsystems and now others are joining in—with enthusiasm. It's designed to keep Microsoft from continually altering the Windows application programming interface (API) to the point where Windows will be a Microsoft-only proprietary system.

Microsoft says that it competes fairly in the applications arena. It claims that just because it develops the operating system software used by most computer users, it doesn't use this to its own advantage to create a quasi-monopoly. Really? Well, the company can prove its assertions by supporting PWI. While PWI will ensure an open Windows standard, it will, ironically,

increase the popularity of Windows and probably increase Microsoft's total sales. Microsoft can still sell Windows by the carload—without the expense of internally developing the API. It's an unparalleled win-win situation (no pun intended). A win for the applications developers who compete with Microsoft. A win for Microsoft. A win for the users who can feel more confident that whatever they buy will not hit a dead end in some distant future.

But does Microsoft want to do this? After all, this increase in sales won't match what a monopoly can accomplish. It's easy to figure that Microsoft won't support PWI and will instead gravitate toward the closed Nintendo approach. After all, the company has said over and over that it wants to dominate the software applications arena.

For proof of just how dangerous and relentless a competitor Microsoft is, just see how effortlessly it can nearly sink a competitor by giving away disk compression and how it can eat into Lotus and WordPerfect sales with foolproof bundling deals. In Microsoft's vision, there's no room for anybody else.

So if Microsoft fights PWI, then it's obvious that Microsoft is headed toward the closed system where it will completely control competitors. I'm so convinced of this that I now recommend to people who plan to run Windows exclusively that they buy only Microsoft applications. Why? Because if the suspected Microsoft plan works, users will eventually have to buy Microsoft apps anyway. They'll be the only ones that work. So we may as well learn the Microsoft apps now and at least be ahead of the poor saps who bought from the competition.



The computer industry may be doomed unless control of Windows is wrested away from Microsoft.

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CIRCLE 081 ON READER SERVICE CARD

Inside Track

Comdex Highlights

Dept.: Here are the top three hot products at this year's Spring Comdex: (1) ———. (2) ———. (3) ———. Well, maybe it wasn't *that* bad, but the show was hardly overflowing with cool goodies.

The **best stuff** was the new technologies crammed in a back-corner booth manned by IBM. It showed the PowerPC chip running at 100 MIPS. A few feet away, IBM's 99-MHz 486DLC3 Blue Lightning was running some graphics programs **maniacally**. In front of the machine was a **huge wafer** from a silicon crystal etched with what looked like a hundred 99-MHz 486s. I believe this slice was there to indicate that the company is going to begin cranking out this **hot little chip** this quarter. Still, the PowerPC chip was more impressive, considering that it's not much bigger than the 486 and performs better than the Pentium.

The **Pentium** got all the attention, with most clone makers showing a machine using the chip. They all claim that they're selling Pentium machines despite the fact that Intel hasn't begun mass production. I think it's time to do some **bait-and-switch** research.

A high-level source at Motorola, who has no love lost for Intel, told me that its chip engineers generally believe that **Intel made a huge error** in trying to make the Pentium using the 0.8-micron bi-CMOS process. "I thought they were smarter than that," he said. He believes, as others do, that until the chip is **re-designed** using a 0.6-micron process it will never go into full production. Of course, the PowerPC uses a 0.6-micron process and will sell for half the price of the Pentium. We'll know soon enough who's right. Intel is laughing all the way to the bank.

The software part of the show was uneventful except for the **final announcement** of Windows NT. Microsoft officially announced it but said it would ship in July. IBM did much the same thing a week earlier but said that OS/2 2.1 will ship June 15.

The show was **abuzz** over the *Wall Street Journal* article about the **fighting and screaming and yelling** in the NT development crew. The article pointed out how some people had quit under pressure. The person responsible for graphics optimization even bailed out. Not the person you want **quitting** such a project, if you ask me. So while schmoozing the showgoers, I was not surprised to discover that NT will supposedly require a direct link to its graphics environ-

All the cool stuff at Comdex was crammed into a back corner at the IBM booth. But the real action was at an imaging show. Xerox debuted a hot new LCD and TI showed the weirdest thing.

ment via an S3 graphics accelerator chip. This will sure make up for the lost programmer but will probably **irk a few users** and a lot of video vendors who are *not* using the S3.

IBM Supports NT Dept.:

Meanwhile, some show-goers were confused over **IBM porting** high-end applications suited for OS/2 to Windows NT. You'd think the company would show some loyalty to its own products. Of course, this is actually a **gambit**. IBM is anxious to see NT get to market. "You can't compare OS/2, which is shipping, to NT until NT ships! When it ships we'll blow it away!" one IBMer told me. Talk is cheap, says I. It seems that IBM is porting to NT just to **develop more evidence** that these apps run better under OS/2.

It's a sales trick. Until NT ships, it'll have the appearance of IBM getting on the NT bandwagon.

If nothing else, the Comdex show was packed. **The real action**, though, may have been elsewhere. At a graphics imaging show, **Xerox was showing off a new LCD technology** that was delivering 300- by 300-dot-per-inch resolution! You heard me right. This is the same resolution you get on a laser printer. In fact, the screen looks like a **printed sheet of paper**. This technology evolved from the need to make ultra-high-resolution high-speed copiers. If Xerox can commercialize this technology, then today's big-dot LCDs will look like a **joke**. Oh, yes, this technology was shown in color as well as monochrome.

While on the Subject of Imaging Dept.: Only a few people noticed that the **weirdest technology ever invented** (as far as I'm concerned) was unveiled by Texas Instruments. It didn't get a lot of attention (yet) since it was announced during Comdex week, but not at Comdex! Dubbed the Digital MicroMirror Device (DMD), it's a small silicon chip $\frac{5}{8}$ inch square **with 300,000 tiny movable aluminum mirrors** over a bed of high-speed logic. These mirrors are **individually controlled**, and (according to TI) when combined with a light source they can outperform any projection TV system yet invented! The proposed system can project a 60-inch VGA image from 12 feet away with a 50:1 contrast ratio. The dinky mirrors are made along with the transistors in the semiconductor manufacturing process and can be **mass-produced**. I found the whole thing so **bizarre and weird** that, to me, it proves that what the **nutballs** have been saying all along is true: The U.S. government has **captured some bug-eyed aliens**. We're using them to design this stuff. □

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Jim Seymour

The Mouse's Tale, 1993

About once a year, I sniff around in the world of pointing devices to see what's new and whether my long-running preference is still on top. Like Punxsutawney Phil, the weather-forecasting groundhog, I look around, try a few new entries,

then pull my head back down for another year.

Word of a new Microsoft mouse on the way reminded me this spring that it was time again for my little ritual. So for the past few months I've been using a variety of new and different mice, trackballs, and other pointing gizmos, at my desk and on the road with notebook PCs.

This year's pointing-device derby was made more interesting than usual by the behind-the-scenes maneuvering going on in developing and marketing computer mice. Now that graphical interfaces, with their demands for pointing devices, are starting to edge character-based interfaces off the field, the business of making and selling mice has gotten both more lucrative and trickier. For example, Microsoft, which is neck and neck with Logitech as the market leader in mice, has other agendas as well, not least the promotion of Windows as a universal interface.

And rising workplace-safety concern over repetitive-stress injuries from using keyboards and pointing devices has made every company in the business wary of litigation over injuries allegedly caused or aggravated by its products.

So this was a ripe moment to dig into the bizarre world of computer mice and related devices.

First, my bias: Any new champ is going to have a tough job displacing my affection for the big Kensington trackballs. I've long found trackballs a more sensible and comfortable solution than wiggle-around devices. Big moves are faster, and tiny moves, to oooch something into place a pixel at a time, are easy. Trackballs also take up less space on your desk, and space has been a big issue on every desk I've had.

Only Kensington uses a really *big* ball—a fugitive pool-ball minus the number—which contributes mightily to both control and comfort.

Clip-on trackballs, such as the Microsoft BallPoint Mouse and the nearly identical Logitech TrackMan Portable, are okay on the road—not perfect, just okay—but I've never liked one clamped on the end of a desktop-size keyboard. They're slow to use since you have to reach over and cup your hand around them to point and click.

Logitech has a newish desktop trackball, the TrackMan, which places a small ball in the middle of a huge swirl. I used it for several weeks and liked it. The relatively massive housing supports your hand and gives you subtle ergonomic hints about where the ball is and how to manipulate it. But for me, the small-diameter ball defeated the TrackMan's otherwise very good performance; I went back to my old Kensington trackball.

THE MONKEY'S PAW

I like the idea of wireless mice, too, but most are unreliable and eat batteries. Logitech's new MouseMan Cord-

less, though, with its odd, monkey-paw design, proved far more reliable and comfortable than earlier designs. Being freed from the mouse-cable (mouse-tail?) tether seemed to make a difference in convenience, though that was largely psychological: Mouse cables aren't a problem, especially if they're made from really limp wire.

The wiggly J key on Sejin America's new keyboard also attracted me—until I connected it to a PC. Pushing a key back and forth—right in the middle of the keyboard—to move an on-screen pointer is a



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Among the ten hard-working utilities you'll find on the disk—created just for readers of *PC Magazine DOS 5 Memory Management with Utilities*—are UMBFILES, which transfers the system file table into upper memory; OPTIMIZE, which eliminates wasted memory and maximizes your system's RAM; and UMASCAN, which identifies unused areas of upper memory that you can convert to usable RAM.

Available at fine bookstores, or call

1-800-688-0448

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Jim Seymour

slick idea, but the Sejin unit is slow and clumsy. That's disappointing, because one of my longtime complaints about outboard pointing devices is that I have to keep moving my hand from the keyboard to the pointing device and then back to the keyboard again. But the Sejin device feels mushy, and I found it hard to control.

I really like the TrackPoint II, the little peg that pops up between the G and H keys on the IBM ThinkPad 700-series notebooks. The peg stands up just far enough that it's easy to locate—for both hunt-and-peck and two-handed typists—but doesn't get in the way when you're typing. Two large buttons at the front edge of the keyboard let you click after you've pointed.

The TrackPoint II's response is perfect, to my taste. It has a smooth, swoopy, nicely accelerated action; you can make major moves across the screen quickly and easily.

The amazing thing about the TrackPoint II is that it doesn't really move at all. It's actually a strain gauge that responds proportionally to the pressure you place against it with your finger (or thumb). That's one reason it has such nice ballistic response, allowing you to make large moves quickly and small fussy moves with great accuracy.

Unfortunately, you can't buy a TrackPoint II mechanism in any hardware except IBM's 700-series portables. (At least, not yet. Why doesn't Lexmark—the IBM spin-off that now produces the nice, original, IBM clackity-clack keyboards—license the TrackPoint II design and build it into a standard desktop keyboard?)

Sigh.

THE DOG'S LEG

This brings me, finally, to the new Microsoft Mouse II. My first reaction to it was about as negative as any I've ever had to a new PC hardware product. An inch longer and a good lump and a half taller than Microsoft's classic "Bauhaus Maus" (or "Dove bar") from mid-1988, Microsoft's new mouse is an ungainly beast. It has a wicked dogleg to the left in the body, and it's as much heavier than the old mouse as it is larger. It did not look like a winner.

Is a bigger, heavier, lumpier dogleg mouse the right path when small, sleek, and linear are hallmarks of good design?

We'll conclude with that segment of *The Mouse's Tale* next month. □

LET'S ALL
GIVE EXCEL
A BIG HAND.

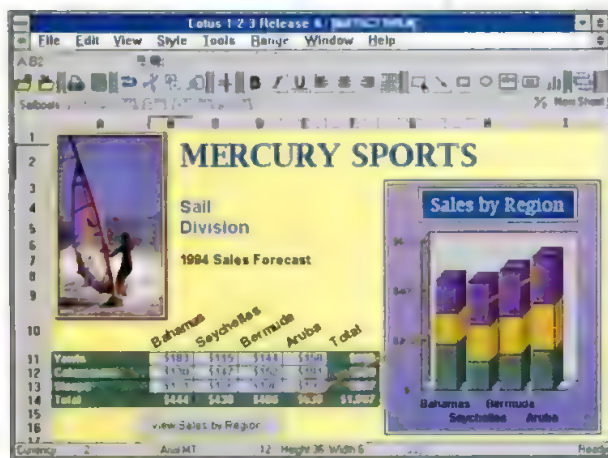
NOW, INTRODUCE YOU'VE BEEN

LOTUS INTRODUCES 1-2-3 RELEASE 4 FOR WINDOWS.

THIS IS CLEARLY A TIME OF CHANGE FOR AMERICAN BUSINESSES.

To keep up with these changes, business people need new and better-suited tools. Lotus® has responded by rethinking and re-creating the spreadsheet as a tool for individuals and for workgroups. 1-2-3 Release 4 incorporates over 4,000 spreadsheet user suggestions. It's dramatically easier to learn and use than any spreadsheet in history. And it's the first spreadsheet that's actually designed to help people work together in impressive new ways.

IT'S MORE POWERFUL
BUT VERY SIMPLE.



While adding dozens of major new features, hundreds of macros and hundreds of tools and @ functions, Lotus has actually simplified the way

1-2-3 leapfrogs
Excel and Quattro...
—PC World 6/93

you work in a spreadsheet.

For example, Release 4 features an @ function pull-down menu to help you

build spreadsheets faster. Cell copying is now a simple drag-and-drop operation, with meaningful visual feedback. And changing text and font attributes is done in one dialog box. (Excel often requires three.)

So 1-2-3® is not only a lot friendlier and easier to use than any other spreadsheet, it's a significant advance over Microsoft® Excel in usability.

THE FIRST
CONTEXT-SENSITIVE
USER INTERFACE.

“The SmartIcons in 1-2-3 for Windows are smarter, and Lotus’ approach to swapping different tool-bars in and out beats Excel’s and Quattro Pro’s.”
—PC Computing 6/93

Release 4 actually anticipates what tools and functions you'll need. Depending on what you're doing, 1-2-3 presents only the menu choices and **SmartIcon™** palettes appropriate to the operation at hand.

This means you won't spend time clicking through menus looking for the features.

IMMEDIATE ON-SCREEN
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A **Live Status Bar** on screen
Automatic | **Arial MT**

shows the attributes of any high-lighted element.

To make a change (like font size or decimal points) you just click on the appropriate section of the status bar. Then scroll up to your chosen attribute and click again.

And unlike Excel, 1-2-3 R 4 includes **In-Cell™ Editing**, so you can enter and edit any information right **in the cell.**

CING THE ACT WAITING FOR.

ONE-STEP CHARTING.

With **One-Step Charting**, you can pick up all titles, data, legends and axis labels right from the worksheet to create a great looking chart the first time, automatically. And you can edit the chart right in your worksheet.

NAVIGATE THROUGH 3 DIMENSIONS.

Anyone who works on multiple worksheets will appreciate the new **1-2-3 Worksheet Tabs** which can be labeled with real words. So you can go directly to any sheet simply by clicking on the appropriate tab.

And Worksheet Tab names are then incorporated into formulas. All of which helps to keep 1-2-3's unique 3D technology simple and easy to use.

12 Height 14 Width 9

DATABASE FUNCTIONS MADE EASY.

“1-2-3 for Windows has always had more powerful database features than Excel or Quattro Pro, and now these features are also easier to use.”
—BYTE 6/93

The 1-2-3 database now has a new, completely graphical interface that makes using it easier than ever. Plus 1-2-3 provides a range of built-in

tools that are powerful without being perplexing.

For example, to modify or create a query, you don't generate criteria and output ranges with cryptic commands. Just bring up the Query Dialog Box and select the fields and records by name. Changing your query is as simple as drag-and-drop.

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Have you ever forgotten why you used a particular number? Or wanted to track more than one value in a cell or range? Suppose you've sent a spreadsheet to a co-worker who develops a whole new version and sends it back? How do you integrate it into your work?

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“It (Version Manager) also makes Microsoft Corp.'s Scenario Manager in Excel 4.0 look like a toy by comparison.”
—PC Week 5/3

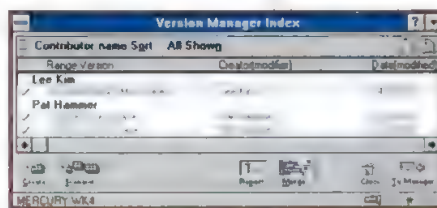
or entire files. And it does it all without overwriting existing data.

If you have Lotus Notes® the work-group benefits of the new 1-2-3 take on even greater proportions. Now different users can access and work on the same spreadsheet at the same time. Notes maintains file integrity and notifies you of changes made by others. So you know you're using the right numbers.

THIS IS THE BIG ONE.

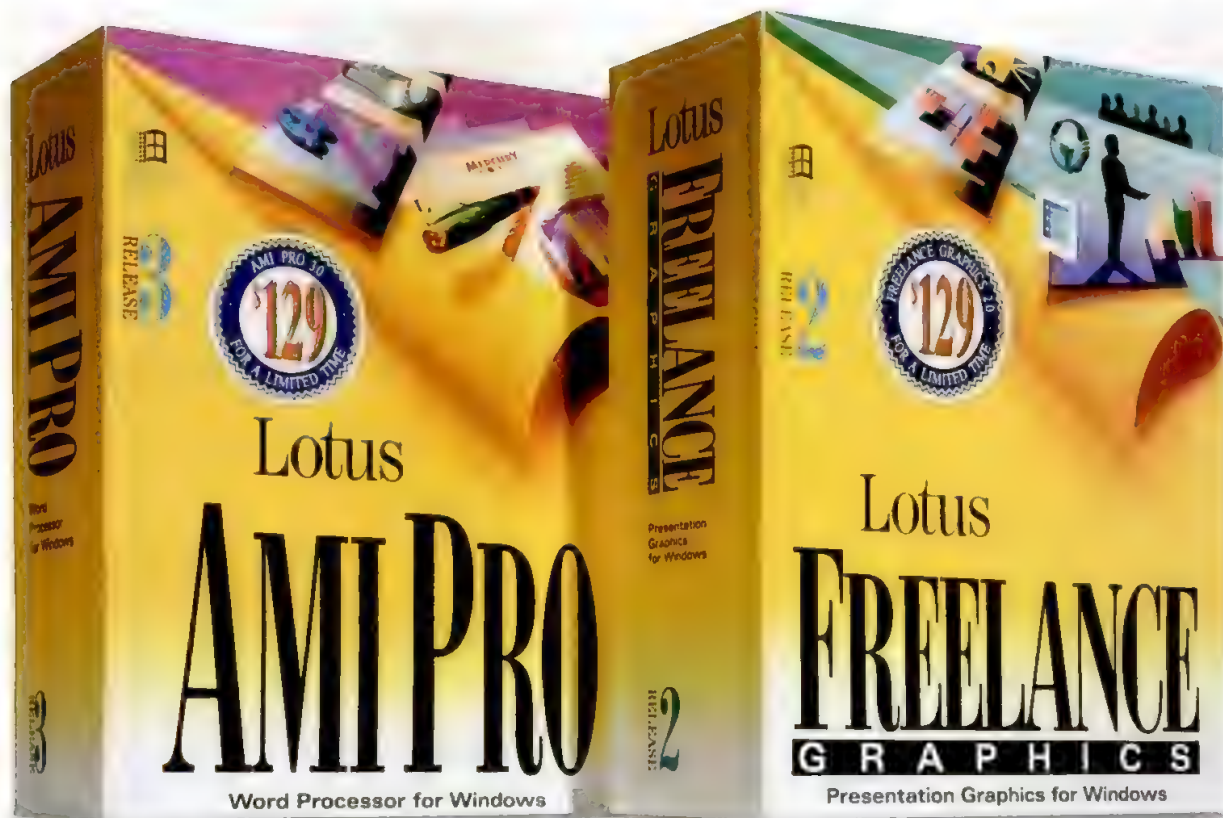
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Lotus 1-2-3 Release 4
SPREADSHEET FOR WINDOWS

1-2-3 IS BACK. AND



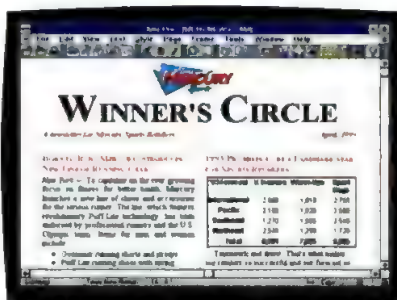
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Ami Pro is rated best word processor. Its tight integration with 1-2-3 Release 4 makes it even better

you're wondering why, there's no time like the present to find out.

Simply put, Ami Pro is a faster, easier, friendlier word processor to use. It produces such great-looking documents with so little effort, most people never even bother to open the manual.

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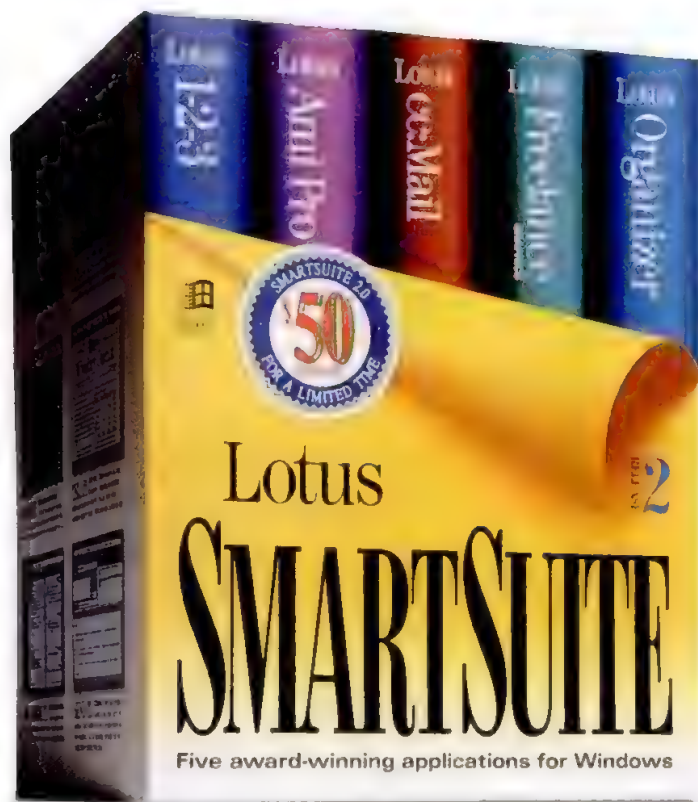
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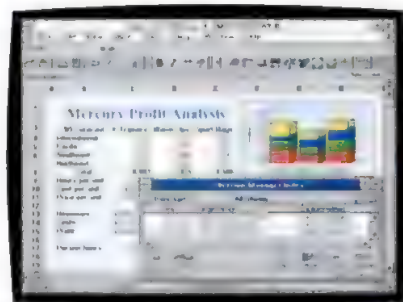
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Once you're comfortable with one application, like 1-2-3, the common look and feel makes you right at home with all five

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Lotus



Bill Howard

Protecting the Premium Line

It's tough to do two things at once and do them both well. Sure, most people can walk and chew gum at the same time, but few can serve two masters, and military leaders know you shouldn't even try to wage a war on two fronts. PC vendors

better take this lesson to heart. You can't make a value line succeed if you're overly concerned about protecting your premium line.

Value lines are not cute placeholders that will keep IBM and Compaq customers in the fold until pesky clone makers like Dell and Gateway 2000 fade. Over time, value lines—the lower-cost offerings from the top vendors—will be the mainstays of the desktop PC business. The core of IBM's desktop business won't be the PS/2. It will be the PS/ValuePoint and PS/1. The transition will be multistep, as the major players learn to react to the competition not once but twice.

- **Step 1: 1987–92.** Dell, Gateway 2000, Northgate, Zeos, and others catch IBM and Compaq napping. ("IBM and Compaq" is shorthand for companies ranging from AT&T to Zenith Data Systems that once sold only high-priced systems.)

- **Step 2: 1992–93.** Major vendors respond with value-line PCs sporting fewer features and lower prices. Reduce margins all around on all lines; squeeze some third-tier players out of business.

- **Step 3: 1993.** Buyers notice that value-line PCs from famous makers don't stack up as well against the compatibles as we thought at first. (IBM's original PS/1 and to a lesser extent Compaq's first ProLinea come to mind.) Often value-line PCs have fewer slots and drive bays, proprietary video, less CPU cache, and less service.

- **Step 4: 1993–94.** Famous makers realize they can't have their cake (protect their premium lines) and eat it, too (hold off the manufacturers of full-featured compatibles) with the same value lines. You can build a product to keep from cannibalizing your premium product, or

you can build a product to compete with the clone makers. But one product can't do both. So, over the next year, the smarter vendors will establish multiple value lines with more features, and their premium lines will increasingly become niche products. Already, value-line systems that started with slow frame-buffer video chip sets have evolved to include accelerated chips, albeit permanently affixed to the motherboards.

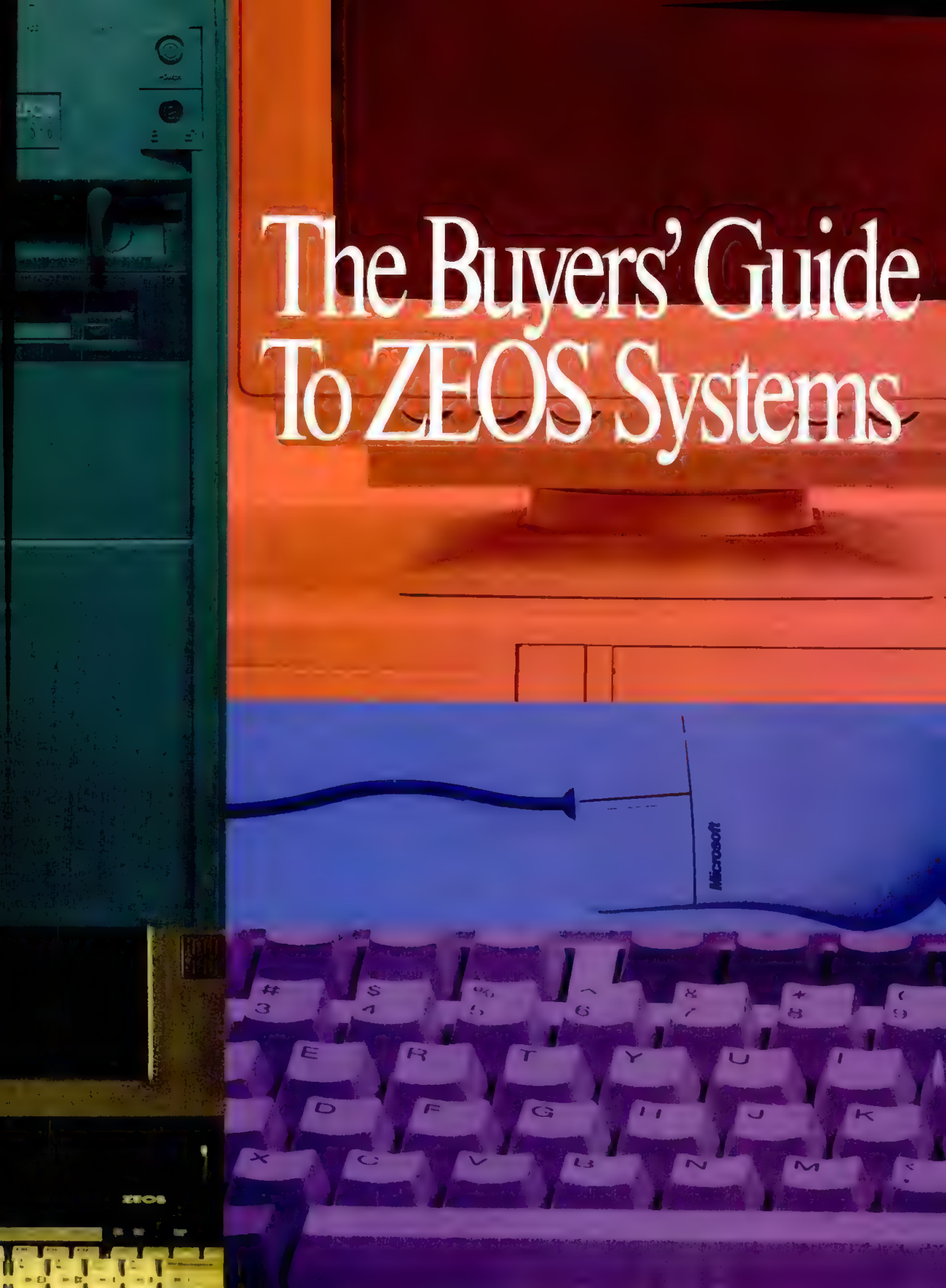
The vendors that prosper will be the ones with the clearest, most defensible marketing positions combined with the best prices and service and support policies. To me, that means vendors that sell *only* value lines and sell them direct. Of the major players, Digital Equipment Corp. fits this description best. Actually, Digital has a premium line, but it's based on the Alpha RISC chip. Little chance of line confusion there.

There's also little confusion between IBM's premium and value lines, because the former uses the Micro Channel, which is now clearly a proprietary architecture. IBM desperately needs a standard advanced bus. The VL-Bus is half a solution (used primarily for video), and Intel's PCI could be a solution, but IBM really needs an EISA bus.

Famous-maker value-line PCs have to be cheap but not dirt-cheap. The buyer still places a premium on the brand name. But it's no longer 30 to 50 percent of the system cost; 10 percent is more like it. In the consumer market, the demand for value may be an off-again, on-again phenomenon rooted this time around in the 1987 Wall Street shakeout. And it's not for all goods. Otherwise people would refuse to pay more than a 10 percent premium for a Cadillac over a Chevrolet. For PCs, the value concept is here to stay. □



You can't make a value line succeed if you're overly concerned about protecting your premium line.



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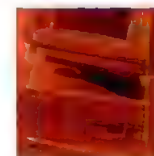
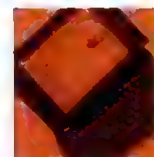
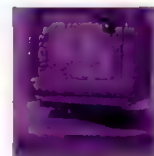
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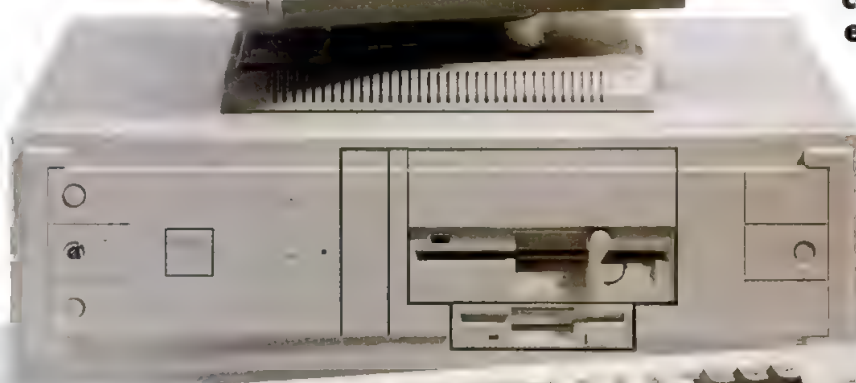
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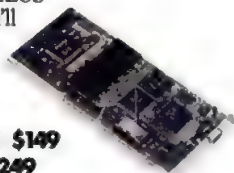
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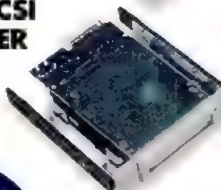
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- ZIF socket for CPU upgrades all the way to the Pentium-based OverDrive processor.
- 256K SRAM cache.
- Two serial ports and one parallel port on the motherboard.
- Six 32-bit expansion slots accept EISA and ISA expansion boards.
- System speed selectable through the keyboard.
- High capacity power supply with built-in surge suppressor and switchable between 115/230V.
- A ZEOS 101-key Reduced Size (RS) keyboard.
- FCC Certified Class B.
- UL Listed.
- Complete ZEOS Customer Satisfaction Package.



FAVORITE OPTIONS

UPGRADES

2MB to 4MB EISA SCSI controller memory upgrade **\$100**

4MB to 8MB EISA SCSI controller memory upgrade **\$200**

COMMUNICATION

2400 bps V42 bis modem with 9600 bps send/receive fax **\$99**

Mylex EISA Ethernet adapter (Coax or AUD) **\$495**

Intel EISA TokenExpress 32 (Coax or STP) **\$749**

Internal CD-ROM drive **\$199**

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24 HOURS A DAY



The ZEOS® L Perfect On The Net

LITELINE AMBRA SYSTEMS

.....
**Upgradable to
OverDrive
processor**
.....

.....
**64K cache for
faster access to
frequently
used data**
.....

.....
**Smaller case
takes up less
space on
your desktop**
.....

.....
**Four bays—
room to add
CD-ROM!**

**We'll install a
network card or
modem at your
request—or
make your
workstation
diskless. Call
us for details!**



Whether it's plugged into your network or plugging away in your home office, the new ZEOS LiteLine Ambra series is the 486SX system you've been waiting for.

Because not only does it give you the power and quality you need, it has something else you want: An affordable price.

Add it right to your LAN—or to your business. It's perfect for word processing and spreadsheet tasks. Not only have we included

quality ZEOS components, keyboards and monitors, but we've added some choice extras: a fast and furious 64K cache, enough bays to add a CD-ROM or tape backup, the option to upgrade to an OverDrive processor, plus a space-saving slim case that won't cramp your style. All at a price that won't put a crimp in your wallet.

iteline Ambra.TM work Or On Its Own.

STANDARD WITH EVERY ZEOS LITELINE AMBRA:

- 486SX microprocessor.
- An OverDrive upgrade socket that gives you upgradability to a more powerful system.
- 64K SRAM cache.
- Two serial ports, one parallel port and one mouse port integrated on the motherboard.
- Five 16-bit expansion slots.
- Small footprint case with four drive bays.
- System speed is selectable through the keyboard.
- A 200 watt power supply, switchable between 115/230V.
- ZEOS 101-key Reduced Size (RS) keyboard.
- Password feature built-in ROM for security.
- FCC Certified Class B, UL Listed.
- Complete ZEOS Customer Satisfaction Package.



PACKAGE 1

486SX-25 **\$1395** Lease \$59/month

486SX-33 **\$1495** Lease \$63/month

- 4MB RAM
- 107MB IDE hard drive with built-in 32K cache
- One 5.25" 1.2MB and one 3.5" 1.44MB floppy disk drive
- Onboard SVGA color video with 512K video RAM
- ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch, tilt and swivel base
- New ergonomic Microsoft Mouse, version 2.0
- MS-DOS 6.0 with Enhanced Tools
- Windows 3.1

PACKAGE 2

486SX-25 **\$1695** Lease \$62/month

486SX-33 **\$1795** Lease \$66/month

- 8MB RAM
- 214MB IDE hard drive with built-in 128K cache
- One 5.25" 1.2MB and one 3.5" 1.44MB floppy disk drive
- Onboard SVGA color video with 1MB video RAM
- ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch, tilt and swivel base
- New ergonomic Microsoft Mouse, version 2.0
- MS-DOS 6.0 with Enhanced Tools
- Windows 3.1

FAVORITE OPTIONS

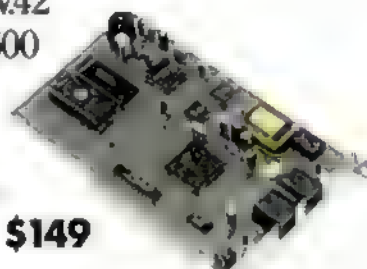
UPGRADES

- 107MB to 214MB hard drive upgrade **\$75**
- 4MB to 8MB memory upgrade **\$172**
- 512K to 1MB video RAM upgrade **\$49**

COMMUNICATION

Internal 2400 bps V.42 bis modem with 9600 bps send/receive fax **\$99** ▶

Intel EtherExpress 16 (Coax or 10BT) **\$149**



MULTIMEDIA

CD-ROM Internal drive **\$199**

Media Vision Fusion multimedia upgrade kit

Includes: Sony 31A internal CD-ROM, 16-bit

Media Vision sound card, and two Labtec CS-550 speakers. **\$599** ▶



Intel EtherExpress 16 (Coax or AUI) **\$149**
Intel Token Express 16/4 (Coax or STP) **\$549**

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24 HOURS A DAY



The ZEOS® Contenda That Great Things Come

ZEOS CONTENDA

.....
**Less than
4 pounds, yet
runs Windows!**
.....

.....
**Intel 386SL or
486SL CPU**
.....

.....
**486SL version
has local bus
video for
Windows
acceleration!**
.....

.....
**VGA backlit
screen**
.....

.....
**Built-in
trackball**
.....



**"...if you're
looking for a
subnotebook
and want to
make next to
no compromises,
then the
\$1395 ZEOS
Contenda is
your best bet."**

—PC Week

Smaller than a notebook. Lighter than your briefcase. The ZEOS Contenda subnotebook is proof that great things come in small packages...including plenty of power to run Windows wherever you go!

We start with a smart Intel SL processor—your choice of either a 386SL-25 or new 486SL-25. You'll find that the Contenda's processor extends your battery life significantly—because it's intelligent enough to power-down the memory, disks, modem and more when they're not in use.

What's more, the Contenda's features make it a pleasure to use. Features such as a high-resolution backlit screen that's crisp and vibrant. A built-in trackball so you won't have to tote a mouse around. And with a standard 80MB hard drive, memory up to 10MB and weight of less than four pounds, it's one powerful, portable Windows workhorse!



nda.™ Solid Proof me in Small Packages.

STANDARD WITH EVERY ZEOS CONTENDA:

- 25MHz 80386SL or 80486SL microprocessor.
- RAM expandable to 8MB for 486SL, 10MB for 386SL.
- IDE hard drive.
- Display: 640 x 480 VGA backlit, .23 dot pitch, Sharp 7.4" diagonal, up to 64 shades.
- 256K (386SL version) or 512K (486SL version) video RAM.
- 486SL version includes 3.3v technology for added battery life, PI local bus for Windows acceleration, high-speed floppy drive controller.
- Supports simultaneous display with an external SVGA color monitor.
- Replaceable and rechargeable NiMH battery.
- 80-key keyboard with embedded numeric keypad and easy-to-use built-in trackball.
- One serial port, one parallel port, one video port, and ports for optional internal fax/modem and external floppy drive.
- AC adapter with full range from AC110-240V to DC.
- Power Management: Fully featured, including De-turbo, programmable Standby features and Suspend to disk.
- Password feature built-in ROM.
- 9.7" x 6.1"; 3.9 lbs.
- FCC Certified Class B; UL Listed.
- Complete ZEOS Customer Satisfaction Package.



PACKAGE 1

386SL Contenda: \$1395

Lease: \$59/month

- 2MB RAM
- 80MB IDE hard drive

486SL Contenda: \$1795

Lease: \$66/month

- 4MB RAM
- 80MB IDE hard drive

PACKAGE 2

386SL Contenda: \$1695

Lease: \$62/month

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

486SL Contenda: \$1995

Lease: \$73/month

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

PACKAGE 3

386SL Contenda: \$1895

Lease: \$69/month

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom nylon carrying case
- Extra battery
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

486SL Contenda: \$2395

Lease: \$87/month

- 8MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom nylon carrying case
- Extra battery
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

FAVORITE OPTIONS

ACCESSORIES

- External 3.5" floppy disk drive **\$99**
- Extra battery **\$99**
- External charging stand **\$79**
- Custom leather carrying case **\$129**
- Custom nylon carrying case **\$79**
- DC-DC adapter **\$49**

MEMORY UPGRADES

- 386SL: 2MB to 4MB upgrade **\$99**
- 386SL: 4MB to 10MB upgrade **\$561**
- 486SL: 4MB to 8MB upgrade **\$198**



COMMUNICATION

- FastLynx File transfer software **\$79**
- Xircom Ethernet adapter (10BT or Coax) **\$349**
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax **\$99**



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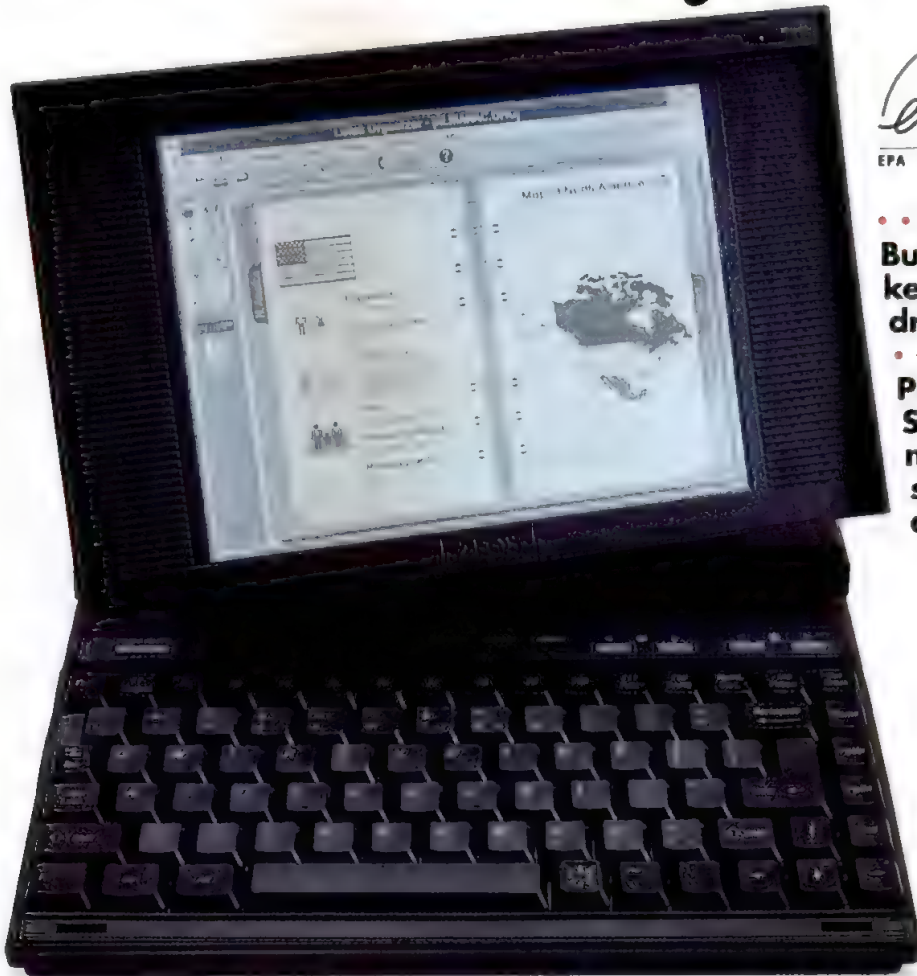
Full Desktop Power You Can Take Anywhere!

THE ZEOS FREESTYLE NOTEBOOK

.....
**386SL or
486SL CPU**
.....

.....
**RAM to 20MB,
hard drive to
180MB**
.....

.....
**Tilt & swivel
display**
.....



.....
**Built-in mouse
key and floppy
drive**
.....

.....
**Plug in an
SVGA color
monitor for
simultaneous
display!**
.....

What do our customers want in a notebook? Not only great looks, you said, but also great power. Lightweight too, like five pounds and change. And with built-in accessories that make it the ultimate in portable power.

The ZEOS Freestyle is the direct result of discussions with our customers. For the most power, now you can choose from either a 386SL or 486SL Intel processor. We've included such features as a built-in mouse key, floppy drive and soft carrying handle. And at

only 5.6 pounds, you'll want to take it with you whenever you travel!

The Freestyle's perfect for frequent flyers. Because the screen floats on a smaller footprint than a normally hinged screen, you can use it without fear of the person in front of you cranking their seat back and doing a "screen crunch" on your system. And check out that great tilt and swivel display. It's one of the few notebooks that can truly be used while sitting in your lap!

STANDARD WITH EVERY ZEOS FREESTYLE:

- 25MHz 80386SL or 80486SL microprocessor.
- 64K SRAM system cache.
- RAM expandable to 20MB.
- IDE hard drive expandable to 180MB.
- 256K (386SL version) or 512K (486SL version) video RAM.
- Internal 3.5" 1.44MB floppy disk drive.
- One serial port, one parallel port, one external video port, one PS/2 port for external keyboard, mouse or 10-key numeric pad.
- Supports an external SVGA color monitor with simultaneous display capability.
- 486SL version includes 3.3v technology for added battery life.
- Replaceable and rechargeable NiCad battery.
- 640 x 480 VGA backlit LCD display, 9.5" diagonal, supporting up to 64 shades of grey.
- Unique tilt and swivel display.
- 81-key keyboard with built-in mouse key, "inverted T" cursor keys and dedicated Home, PgUp, PgDn, and End keys.
- AC adapter with full range from AC110-240V to DC.
- Power-saving features include: programmable multi-level sleep features, built-in Suspend/Resume functions including save-to-disk.
- FCC Certified Class B.
- Complete ZEOS Customer Satisfaction Package.



PACKAGE 1

386SL Freestyle: \$1295

Lease: \$55/month

- 2MB RAM
- 80MB IDE hard drive
- MS-DOS 6.0

486SL Freestyle: \$1695

Lease: \$61/month

- 4MB RAM
- 80MB IDE hard drive
- MS-DOS 6.0

PACKAGE 2

386SL Freestyle: \$1795

Lease: \$65/month

- 6MB RAM
- 120MB IDE hard drive
- Custom nylon carrying case
- MS-DOS 6.0
- Microsoft Windows 3.1

486SL Freestyle: \$1995

Lease: \$72/month

- 4MB RAM
- 120MB IDE hard drive
- Custom nylon carrying case
- MS-DOS 6.0
- Microsoft Windows 3.1

PACKAGE 3

386SL Freestyle: \$2295

Lease: \$83/month

- 10MB RAM
- 180MB IDE hard drive
- Internal 2400 bps V.42 bis modem with 9600 bps send/receive fax
- Custom nylon carrying case
- Extra battery
- External charging stand
- MS-DOS 6.0
- Microsoft Windows 3.1

486SL Freestyle: \$2495

Lease: \$90/month

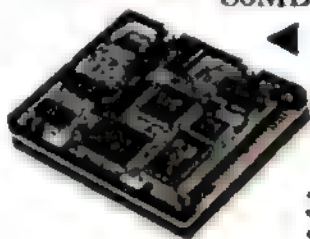
- 8MB RAM
- 180MB IDE hard drive
- Internal 2400 bps V.42 bis modem with 9600 bps send/receive fax
- Custom nylon carrying case
- Extra battery
- External charging stand
- MS-DOS 6.0
- Microsoft Windows 3.1

FAVORITE OPTIONS

HARD DRIVE UPGRADES

80MB to 120MB \$195

◀ 80MB to 180MB \$345



MEMORY UPGRADES

386SL: 2MB to 6MB \$330

2MB to 10MB \$660

486SL: 4MB to 8MB \$330

4MB to 20MB \$1320

ACCESSORIES

386SL: Intel 387SL-25 math coprocessor \$99

SVGA color monitor (With notebook purchase) \$395

101-key external keyboard \$49.95

Turn your notebook into a desktop PC!

VGA color monitor, keyboard and mouse. (With notebook purchase) \$499

Extra Battery \$50

External Charging Stand \$69

Custom leather carrying case \$129 ▶

Custom nylon carrying case \$79



COMMUNICATION

Internal 2400 bps V.42 bis modem with 9600 bps send/receive fax \$169 ▼

Xircom Ethernet adapter (10BT or Coax) \$349



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24 HOURS A DAY



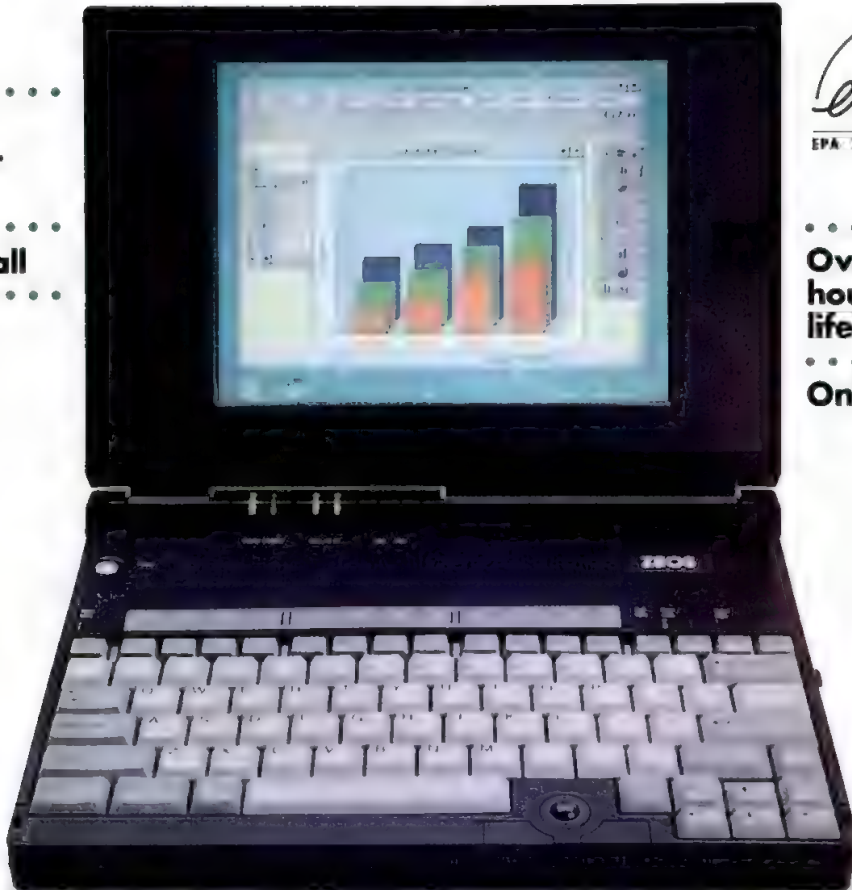
Incomparable Color, Unbelievable Value.

**486SX-33
power**

**Dual scan LCD
technology for
vibrant color**

Built-in trackball

**Built-in floppy
drive and
PCMCIA slot!**



**Over three
hours battery
life**

Only 5.6 lbs.!

ZEOS's new ColorNote 486 starts with a powerful, reliable Intel 486SX processor operating at 33MHz—not just 25MHz like many other color notebooks. We've packed in enough power and memory to easily run Windows: 4MB RAM (expandable to 20MB), an 80, 120 or 170MB hard drive, and an 8K built-in cache—standard.

For a crisp, vibrant color VGA display, the ColorNote employs a new technological breakthrough—dual scan technology—for color that's much better than standard passive matrix, yet not as expensive as active matrix. You get color

that's comparable to that of a great desktop color monitor! What's more, your screen is backlit, 9.4 inches on the diagonal, and gives you up to 256 colors.

Color technology can drain a notebook's power. So that you can get up to three hours—and beyond—of battery life, the ColorNote uses a Nickel-Metal Hydride battery. It also comes equipped with an internal 1.44MB floppy drive and PCMCIA slot. All this—and the ColorNote weighs a mere 5.6 pounds, including the battery!

PACKAGE 1

ColorNote 486: \$2695

Lease: \$98/month

- 4MB RAM
- 80MB IDE hard drive

STANDARD WITH EVERY ZEOS COLORNOTE 486:

- 33MHz 486SX microprocessor.
- RAM expandable to 20MB.
- IDE hard drive expandable to 170MB.
- 8K internal cache.
- Internal 3.5" 1.44MB floppy disk drive.
- PCMCIA slot supporting a type I, II or III device.
- 512K video RAM.
- Display: 640 x 480 dual scan color VGA backlit LCD, 9.4" diagonal, up to 256 colors.
- Supports an external SVGA color monitor at resolutions up to 1024 x 768, 16 colors or 800 x 600, 256 colors.
- 82-key keyboard with embedded numeric keypad and 12 dedicated function keys.
- Built-in trackball.
- Replaceable and rechargeable NiMH battery.
- One serial port, parallel port, keyboard port, mouse port and external video port.
- Full power management features include Low Power mode and programmable Stand-by features.
- AC adapter with full range from AC110-240V to DC.
- 8.54" x 11.65" x 1.5"; 5.6 lbs.
- FCC Certified Class B; UL Listed.
- Complete ZEOS Customer Satisfaction Package.



PACKAGE 2

ColorNote 486: \$2995

Lease: \$109/month

- 4MB RAM
- 120MB IDE hard drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

FAVORITE OPTIONS

HARD DRIVE UPGRADES

- 80MB to 120MB upgrade **\$195**
- 80MB to 170MB upgrade **\$345**

MEMORY UPGRADES

- 4MB to 8MB upgrade **\$198**
- 4MB to 20MB upgrade **\$1495**

COMMUNICATION

PCMCIA
2400 bps
modem with
9600 bps
send/
receive fax
\$249 ▶



FastLynx
File transfer software **\$79**
Xircom Ethernet adapter
(10BT or Coax)
\$349

PCMCIA

- PCMCIA 512K SRAM card **\$149**
- PCMCIA 1MB SRAM card **\$199**
- PCMCIA 2MB SRAM card **\$299**
- Other PCMCIA products **Call**

ACCESSORIES

Custom leather carrying case

Plenty of
pockets
for all your
file folders!
\$129 ▶



PACKAGE 3

ColorNote 486: \$3395

Lease: \$113/month

- 8MB RAM
- 170MB IDE hard drive
- Custom nylon carrying case
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

- Custom nylon carrying case **\$79**
- Extra Battery **\$99**
- External 5.25" floppy disk drive **\$279**
- SVGA color monitor **\$395** ▶
- 101-key external keyboard **\$49.95**
- External numeric keypad **\$79**
- Microsoft Mouse **\$79**



POWER

External charging stand

Quick-charges and deep discharges your battery. Perfect for the traveler **\$79**

Extra AC Adapter

Keep one at home and one at the office! Or use it with your external charging stand **\$69**

DC-DC Adapter

Run your system in your car, boat, or other vehicle **\$49**

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800-554-7172
24 HOURS A DAY



Want Your Computers Now? We Can Ship Today!

- It's as easy as
1. Choose what system package you want. (A sampling of what's available is shown on the opposite page.)
 2. Call ZEOS at 800-554-7172 before 1 p.m. Central Time, Monday through Friday, to place your order.
 3. Upon credit approval, we'll ship your system *the same day you order!*



OUR GUARANTEE TO YOU:

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.

JUST A FEW RULES:

- Orders must be for ZEOS Computers Now!™

configurations; we've listed just a sampling here. Since we continuously add to this list of configurations, *please call to confirm your system is on the list.* Any other ZEOS systems and custom configurations take slightly longer—about a week.

- Credit cards are subject to authorization.
- Orders must be received by 1 p.m. Central Time, M-F.

NOTE: Complete features are listed on the previous pages.

**486SX-25****PACKAGE #2:**

- 4MB RAM
- 214MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$1695**486DX-33****PACKAGE #2:**

- 4MB RAM
- 214MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$1995**486DX-33****PACKAGE #3:**

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2295**486DX2-66****PACKAGE #3:**

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2495**486
DX2-66****PACKAGE #3 PLUS:**

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- Diamond Viper video card
- Vertical case
- 15" SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2834**486
DX2-66****PACKAGE #4:**

- 16MB RAM
- 540MB local bus hard drive with built-in 256K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2995**486
DX2-66****PACKAGE #4 PLUS:**

- 16MB RAM
- 540MB local bus hard drive with built-in 256K cache
- Windows-accelerated local bus video
- Diamond Viper video card
- Vertical case
- 15" SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$3334**LiteLine
Ambra
486SX-25****PACKAGE #1:**

- 4MB RAM
- 107MB hard drive with built-in 32K cache
- Both floppy drives
- SVGA color monitor
- DOS, Windows, Mouse

\$1395**Contenda
386SL****PACKAGE #2:**

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy drive
- DOS, Windows, Organizer

\$1695**Contenda
486SL****PACKAGE #3:**

- 4MB RAM
- 80MB hard drive
- Local bus video
- Nylon carrying case
- Extra battery
- Internal send/receive fax modem
- DOS, Windows, Organizer

\$2395**Freestyle
386SL****PACKAGE #2:**

- 6MB RAM
- 120MB hard drive
- Nylon carrying case
- DOS & Windows

\$1795**Freestyle
486SL****PACKAGE #3:**

- 8MB RAM
- 180MB hard drive
- Nylon carrying case
- Internal send/receive fax modem
- Extra battery
- External charging stand
- DOS & Windows

\$2495

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ZEOS
 INTERNATIONAL LTD.

You Get Great PCs And More!

SERVICE AND RELIABILITY THAT WINS AWARDS.

We're the only company to win *PC Magazine's* Readers' Choice for Service & Reliability—for both desktops and notebooks—*twice!*

AWARD-WINNING REPUTATION.

Nine times *PC Magazine* Editors' Choice! And ZEOS has twice won *PC World's* Best Buy, *Computer Shopper* readers' #1 Best Buy, and *Info World's* Buyer's Assurance Award.



EXCEPTIONAL QUALITY.

UL® Listing on the entire system—not just the power supply. FCC Class B certification. Plus features like two cooling fans and built-in surge sup-



pression that ensure longer system life.

IMPORTANT EXTRAS.

Such as free Windows applications from Lotus. Most packages include DOS 6.0 with Enhanced Tools, Windows 3.1, and your choice of either 1-2-3, Ami Pro, Freelance, Improv or Organizer. You save hundreds of dollars!



TOLL-FREE TECH SUPPORT AT ANY HOUR.

We're here for you 24 hours a day, 365 days a year, and always a toll-free phone call away.

WE SUPPORT YOU OTHER WAYS, TOO:

FactFax: For our automated Technical Support fax service call

800-845-2341 and select the information you need.

PRODIGY: Type "ZEOS" as your jump word.

COMPUSERVE: Type "GO ZEOS"

INTERNET: sales@zeos.com or products@zeos.com.

Plus our own free Bulletin Board Service for immediate updates and more!

WARRANTIES & GUARANTEES.

All ZEOS systems come with a One Year Limited Warranty, Express Parts Replacement Policy and a 30-Day Money-Back Guarantee. If you're not absolutely satisfied with your new system, return it to us for a refund of the purchase price. No questions asked!

ON-SITE SERVICE.

Optional on-site service is available for only \$49 the first year. Options can be purchased during the first 30 days you own your new system.

MORE WAYS TO PAY.

In addition to offering affordable leasing terms, we also accept MasterCard, VISA, Discover and American Express, plus purchase orders, COD, cashiers checks, money orders or cash in advance. You can also pay with **the Z-CardSM**—which works just like any other credit card—so you can charge your ZEOS purchases and pay in easy monthly installments. And there's no annual fee! Call us today and we'll fax or send an application, 800-544-7172.

CALL NOW TOLL FREE
800-544-7172
24 HOURS A DAY

ZEOS
INTERNATIONAL, LTD.

TAKE IT FROM OUR CUSTOMERS.

"...thank you for a fine personal computer. It is well made. This is one solid machine; there are no shortcuts in this desktop...Since 1988, I have looked at and inside, of a lot of computers. There is no comparison to ZEOS."

—Chester Estes, Jr.,
Computer Specialist,
Union, MS

"I just had to write and tell you how happy I am with the ZEOS I bought through you. It is a fast, well designed and quality constructed machine—a class act."

"I am particularly impressed with your 24-hour customer service. I've had a few occasions to call and found the staff extremely pleasant..."

—Don Trivette,
Contributing Editor,
PC Magazine
Wrightsville Beach, NC

"If this is the kind of service you receive from direct-marketing companies, I don't think I'll ever step into another computer store again!"

—Sgt. Ron Hutchins,
Kaneohe Bay, HI

Go With ZEOS.

Money-Saving Packages or Custom Configurations

Here's a summary of some of our most popular packages. Complete features are listed on the previous pages. If you need further info, give us a call. And remember, we do custom configurations too!

486SX-25

- 4MB RAM
- 214MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$1695

add \$100 for a 486SX-33!

486DX-33

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2295

add \$100 for a 486DX2-50!

486DX2-66

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2495

486DX2-66

- 16MB RAM
- 540MB local bus hard drive with built-in 256K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

\$2995

EISA 486DX2-66

- 16MB RAM
- 1.1GB SCSI hard drive
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The trend to portable computers is the latest step toward making computing truly a part of our lives. In this, our third annual summertime portable computer issue, we look at the tremendous strides being made in notebook computers, peripherals, and soft-

in the future, as witness the 10 new machines previewed in the sidebar "Up Next."

Soon we expect to see even smaller, lighter, more portable machines, some with keyboards and some with alternative user interfaces. Call them personal digital assistants, personal communicators, or personal

P O R T A B L E C O M P U T I N G

Power Without The Pounds

ware. We also explore the potential of related new technologies.

Just a few years ago, it seemed that portable computers would always lag behind their desktop counterparts in power, speed, and expandability. But look at the 68 remarkable systems we review in "The Portable Puzzle." They range from inexpensive monochrome systems to full-featured computers with great color, lots of memory, and hundreds of megabytes of hard disk storage. And of course this breed will be even more powerful

information processors—they promise to become part of our everyday lives. Many of us will want to have them connected to wireless networks for immediate contact with the information we have in our offices. Wireless communication is still in its infancy, but it offers enormous promise. We take a look at this fascinating technology in "Connecting over the Airwaves." Computing has gone from the glass room to the desktop and now to the briefcase and the laptop. It may soon be a constant companion.





WHICH IS RIGHT FOR YOU?

The Portable Puzzle

W

hat does it take to get a break in the laptop business today? That's the question on the lips of the vast majority of portable computer vendors. With such a stunning variety of products a consumer can choose from, the short answer is to do everything right, from design and engineering all the way through to service and support.

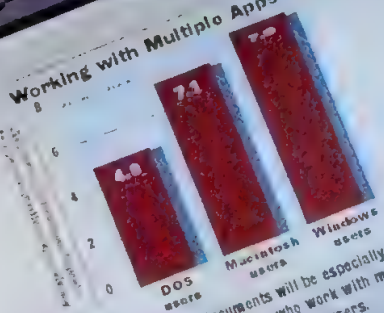
This big question is paramount among the vendors who are typically labeled as "others" on charts depicting market share. These are companies selling speedy, capable 6- and 7-pound note-

With such an embarrassment of notebook riches to choose from, confusion reigns. *PC Magazine* fits the pieces together to help you make sense of the picture.

by *Bill Howard*



Working with Multiple Apps



Building compound documents will be especially important to Windows users, who work with more applications than Macintosh or DOS users.

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book computers with 386- and 486-level CPUs. And while many have what would have seemed like bargain-basement prices a year ago, they still include color displays, PCMCIA slots, and built-in pointing devices. Yet, as a group these firms are actually losing market share to the top ten vendors who now control about three-quarters of the portable PC market. These 50 to 100 "others" must fight for the remaining quarter.

That's one of two notable ironies in the notebook business today. The other: Despite rapid advances in technology and packaging, the next notebook you buy may weigh more, cost the same, and have worse battery life than the notebook you're carrying around today. That's because of the increased demand for color systems, which are generally heavier,

more expensive, and have shorter battery lives than their monochrome brethren.

In this issue of *PC Magazine* we sort through the gamut of issues concerning portable PCs, from our reviews of 64 notebooks and four subnotebooks to companion stories on portable multimedia machines, the Apple PowerBook, battery technology, and the first generation of PCMCIA products. You'll also find reviews of six battery-powered portable printers and a look at wireless communications technology. And we've included a foldout guide that covers the basic information you need for staying in touch on the road.

NOTEBOOK DIRECTIONS

In an industry so competitive that a company is only as good as its present prod-

ucts, movement is quick. Some of the more important trends indicate where the notebook market is heading:

- **The 486 reigns.** Of the 68 systems we reviewed, 51 have some flavor of 486 CPU from Cyrix, IBM, Intel, or Texas Instruments. Megahertz for megahertz, the 486 provides twice the processing oomph of a 386 CPU. Unless \$1,000 is your price ceiling, there's no compelling reason to buy a 386-based portable today.

- **Color beckons.** No longer must you turn to costly active-matrix LCD panels for a decent color display. The new dual-scan (or *double-scan*) technology, makes less expensive passive-matrix color displays acceptable.

- **Weight is down, battery life up.** The average road weight of the systems reviewed has dropped 4 ounces to 7.5 pounds since the last time we looked at portables. Average battery life of tested systems rose slightly to about 2 hours 25 minutes. The average price of a system has leveled off to \$2,850, after many months of sharp declines.

- **Built-in pointing devices are a must.** As Microsoft Windows becomes de rigueur on the road, users are shunning separate trackballs or mice. The dividing line between acceptable and klunky is the snap-on cordless trackball.

- **Value lines take off.** Attempting to cash in on brand-name recognition, Compaq and Toshiba have launched their value lines—Contura and Satellite, respectively. Budget systems generally offer slightly lower performance and fewer features.

- **PCMCIA proliferates but is lacking.** While intended to be plug-and-play, the PCMCIA accessory slot is anything but. PCMCIA slots are on 16 of the systems we tested, and there's been a flurry of products: modems, network adapters, hard disks, and flash memory.

REVIEW CRITERIA

For inclusion in this issue, we sought all products that had been released or significantly upgraded since our last roundup (March 30, 1993). Systems had to be shipping as of early April and have a travel weight (system, battery, power adapter, and cord) of no more than 9 pounds. We sought systems with at least a 386 CPU, a hard disk with at least a 60MB capacity,



EDITORS' CHOICE

and DOS and Windows preloaded. Testing took place in April and May and prices are current as of early June. Units that were sent too late to be tested are described in a two-page addendum.

Our search criteria netted us 68 systems from 32 vendors. These systems are based on 20 different types of CPUs manufactured by AMD, Cyrix, IBM, Intel, and Texas Instruments. The processors range from a 20-MHz 386 all the way through the 486DX2/66. Fifteen of the 68 systems used non-Intel CPUs. Note that some of the 486-labeled systems are hybrids. It is important to remember that the Cyrix 486SLC/25, Cyrix 486SLC/33, and clock-doubled IBM 486SLC2/50 all have 16-bit memory paths, as do 386SX-class CPUs, but not the more capable 486s.

The two most popular CPUs among the tested machines belong to Intel's power-saving SL family—the 386SL/25 and the 486SL/25—found in 13 and 11 systems, respectively. Later this summer you can expect a 33-MHz 486SL, the last chip to carry the SL name, which will deliver about 25 percent more processing power than its 25-MHz cousin. Intel will continue to migrate the functional attributes of the SL into its desktop chip lines. This not only means that power-managed desktop systems are ahead, but that manufacturers will not have to stock DX- and SL-type CPUs of the same clock speed.

Because of the variety of CPU types and speeds, performance levels varied widely. On PC Magazine Labs' benchmark tests, the fastest processor score surpassed the slowest by a ratio of 6 to 1. This hierarchy of performance shows that careful engineering counts for at least as much as the speed of the CPU. In terms of raw CPU power, 486DX2/50 portables actually outperformed 486DX2/66 systems. The TI TravelMate 4000 WinDX2/50, the similar Gateway Nomad 450DXL, and the HyperBook 2300DX2/50 averaged 12,287 processor operations per second and finished first, second, and third in the processor test. The next four finishers were 486DX2/66-based units that averaged 11,173 processor operations per second. The top seven units were able to process data twice as fast as the average notebook.

- **Compaq Contura 4/25CX**
- **Gateway Nomad 425SXL**
- **Gateway Nomad 450DXL**
- **IBM ThinkPad 720C**
- **TI TravelMate 4000 series**

In judging this wide palette of both old and new, of stripped-down and feature-rich portable PCs, we returned to the basics of portability: size, weight, battery life, performance, and screen quality. Those that stood out from this highly qualified pack of 68

portables seamlessly combined these elements to create roadworthy PCs. The best will satisfy you and should continue to keep up as mobile computing becomes more demanding.

A STEP AHEAD

The TI TravelMate 4000 family members we reviewed and the nearly identical Gateway Nomads—the 425SXL and 450DXL—pack power into small, lightweight packages. These two product lines include notebooks for virtually every budget and computing style. The units do still lack PCMCIA slots and active-matrix color screens, but both features are on the way.

Close on the heels of the very successful IBM ThinkPad 700C, the IBM ThinkPad 720C is lighter and more utilitarian, yet retains the 10.4-inch active-matrix color screen—today's best notebook display. Weighing nearly 9 pounds, the 720C can be a lot to lug around, though.

The Compaq Contura 4/25CX is the first value-line portable that doesn't scrimp on features or performance. It either beat or kept up with its Compaq LTE Lite 4/25C cousin on our benchmark tests. The 4/25CX is a lower-priced alternative with similar performance levels, but it lacks expansion port capabilities.

NOT FAR BEHIND

Several systems were impressive, but disappointed us in one way or another:

they rated Honorable Mention.

A newcomer, the Micro Electronics WinBook 486SLC/E/33, impressed us by pairing a very usable built-in trackball with a low price tag. It lacks an optional color screen, however.

The NEC UltraLite Versa 486/SL combines excellent benchmark test results—a ranking among the top three in its CPU class for processor, memory, and video scores—with an appealing design. Its unique reversible screen is balanced by the lack of a built-in trackball and its huge power adapter.

The Compaq LTE Lite 25E remains the only active-matrix monochrome portable, and easily has the most readable monochrome screen, but it really should have a 486 CPU. (The Compaq LTE Lite 4/25E, powered by a 486SL/25 chip, shipped too late for this review.)

A pair of identical twins—the AST PowerExec 4/25SL Color Plus and the DECpc 425SL—led the pack in putting together an amalgam of features, performance, and battery life. Add to that a front-mounted clip-on trackball and you have 8-pound marvels.

One system of note is the Toshiba T4500C, whose combination of lightness, long battery life, and excellent screen virtually established the power notebook segment. Today, the T4500C has been left behind by its competitors, but its shortcomings are addressed in the new T4600C.

HIGHLIGHTS Portable PCs

CHOICES, CHOICES. From 4-pound subnotebooks to 20-pound suitcase multimedia machines, the portable PC arena has exploded with choice. We tested 68 new or significantly improved units and took a look at several others.

THE AVERAGE PORTABLE PC today is powered by a 486 processor, has a monochrome screen, weighs 7.5 pounds, has a battery life of about 2 hours 25 minutes, and costs \$2,863.

PCMCIA SLOTS were present on 16 of our test systems, but their rapid acceptance by portable makers appears to be outpacing the number of available and compatible PCMCIA devices.

COLOR PORTABLES are making tremendous inroads due primarily to the increasing sophistication of passive-matrix color displays. The best passive-matrix units use a *dual scanning* technique to improve color depth and sharpness and reduce shadowing.

VALUE-LINE NOTEBOOKS such as the Compaq Contura series and the

Toshiba Satellite T1850C are giving smaller vendors a run for the money.

QUALITY ENGINEERING SHOWED in two 486DX2/50 systems—the nearly identical TI TravelMate 4000 WinDX2/50 and Gateway Nomad 450DXL—that beat more powerful DX2/66 systems in raw computing performance.

THREE LASTED FOUR HOURS or more on battery tests. The ZDS Z-Note 425Ln Model 120, the TI TravelMate 4000 WinSX/25, and Digital's DECpc 425SL achieved the best compromise between power and battery weight. The best battery time for a color unit belongs to the Dell 325NC, which uses a 386 processor and a passive-matrix color screen to last just under 3 hours.

BUILT-IN POINTING DEVICES vary in comfort and ease of use from the Apple PowerBook's large, front-mounted device to many smaller and less useful ones. IBM's TrackPoint II and Micro Electronics' small, front-mounted trackball were the best.

The progression of processing power since our last portables review is shown by the performance midpoint in this review, which is held by the 11 486SL/25 notebooks that averaged 5,578 processor operations per second. This is almost twice as fast as the previous generation of 386SL/25s, which averaged roughly 3,000 operations per second.

In addition, our tests show a 5-to-1 ratio between the fastest and slowest video subsystems. The five best video performers under Windows, in descending order, were the IBM ThinkPad 720C, the NEC UltraLite Versa 25C (the first laptop with a video local bus), the PC Brand Active Color LeaderBook Pro, the Toshiba T4400C, and the HyperBook 2300DX2/50. In all, 18 systems performed at or above the 3-megapixel-per-second level; the ThinkPad 720C surpassed the 5-megapixel-per-second mark.

For the first time in a portable PC roundup, we used the PC Labs' Windows Applications test suite, which approximates the demands of a multitasking environment by timing a computer's performance on four popular Windows programs. The best score was turned in by the Twinhead Slimnote 4DX2/66T.

For many users, the most important measure of a portable's worth is battery life. We performed both our worst-case Battery Rundown test (with all power-conservation features disabled) and the ZDigit Rundown test, which exercises the system, puts it in standby mode, and then triggers its power-conserving sleep mode before starting the cycle again.

In terms of Battery Rundown test scores, three monochrome 486 systems topped 4 hours: the ZDS Z-Note 425Ln Model 120, at 4 hours 23 minutes; the TI TravelMate 4000 WinSX/25, at 4 hours

THE APPLE POWERBOOK line continues to amaze with superior ergonomics; the downside is higher cost, sluggish performance, and short battery life.

HP'S OMNIBOOK 300 may be the first acceptable subnotebook. Based on a relatively weak 386 CPU and utilizing a nonbacklit screen, it has its shortcomings.

PORTABLES WITH CD-ROM may seem more like an oxymoron than an engineering trend, but there are several lug-gable systems out there that are perfect for high-quality graphics or presentations.

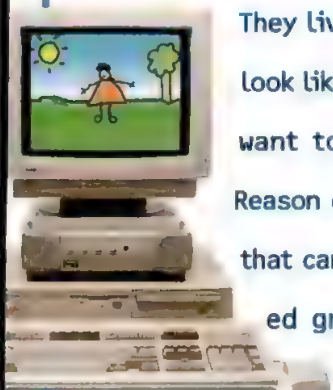
INTEL'S POWER-SAVING SL CPU family provided the most popular processors in this review; they were used in more than a third of the systems we tested.

IBM'S THINKPAD 720C continues where the 700C left off. It is not only lighter and more utilitarian but still uses the same 10.4-inch color display—easily the best in the business today.

18 minutes; and the DECpc 425SL, at 4 hours 3 minutes. The best battery time for a color portable belongs to the Dell 325NC, which uses a 386 processor and a passive-matrix color screen to last just under 3 hours. The bottom line is that it's not unreasonable to expect a monochrome PC to run for at least 2.5 hours and a color system to last in the neighborhood of 2 hours.

We expect battery performance to improve by 1994 as nickel hydride cells and other innovations take hold (for more information, see the sidebar "Power to the Portables"). Another approach to battery life is to use an advanced core logic chip set that can vary the system clock speed to suit the required level of computing. One such chip set is Evergreen, from PicoPower Technology (408-954-8880), which makes its debut on the CompuAdd 425TX system.

Statistics Say You Already Have 2.3 Good Reasons To Buy A Tandy Sensation.



They live in your house and they look like you. And someday you'll want to send them to college. Reason enough to own a computer that can demonstrate with animated graphics just how a plant converts sunlight into

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graphics to produce a

truly amazing 5th
grade science paper.

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done—if you ever get to use it. But if demo-

graphics alone aren't going to convince

Overall kudos go to Tandy's Sensation; it's a well thought out execution of what every MPC (multimedia personal computer) system manufacturer should strive to emulate.

Greg Loveria
-BYTE Magazine
May 1993

you to add a Sensation to your household, then perhaps a positive review by a well-respected computer journal will.

Which, in fact, we have as a result of a recent article written by Greg Loveria for *BYTE* Magazine. In it, Mr. Loveria chose the Sensation, with its built-in CD-ROM drive and powerful 486SX micro-processor, as his overall recommendation for multimedia personal computer systems. A statistically significant ranking,

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WHO'S WHO...AND WHY

Three companies that have stressed innovation in their products are Apple, Compaq, and Toshiba, and each claims about 15 percent of the notebook market, based on a survey from the end of 1992. AST, Dell, Sharp, Tandy/GRiD, and Texas Instruments each command 5 to 7 percent of the market. Just behind them are NEC and Zenith Data Systems (ZDS), two late-1980s high fliers that recently stumbled, and IBM, which is only now emerging from a decade-long string of klunkers. The Apple PowerBook thrived last year primarily because its innovative design fulfilled the market's pent-up demand for a decent Macintosh portable. Nevertheless, the unit suffers from inferior battery life and a high price tag.

A comparison of two pairs of manufacturers shows where this market has been and where it is heading. Toshiba, which hasn't stumbled in the eight years since the breakthrough T1100 system came out, has been the most consistent player. The Toshiba T4500C has an unrivaled keyboard, a PCMCIA slot, and a high-quality 8.5-inch color screen, but lacks an integrated trackball, making do with a snap-on QuickPort version of the Microsoft BallPoint. By contrast, the Compaq LTE Lite 4/25C has a faster 25-MHz CPU, a roughly equivalent size, a lighter weight, a dedicated modem slot for a 14,400-bps data/fax modem, and a trackball incorporated into the case.

Dell Computer Corp. and NEC Technologies bear scrutiny for opposite reasons. After a dry spell, NEC once again has a highly competitive product in the NEC UltraLite Versa 25C, a 486SL/25 system with a removable 9.5-inch active-matrix color display that can be turned

to face a group for presentations. Conversely, Dell's dry spell is here and now; its aging products don't include any 486 systems and probably won't until 1994.

What Dell has done well is boost its value-oriented NL line of notebooks. The trend toward giving the buyer an inexpensive alternative is also seen at Compaq (Contura), IBM (PS/Note), Toshiba (Satellite), and ZDS (Z-Sport). For some companies, value-line computers represent half their sales volume.

In comparison to their higher-priced siblings, the value-line notebooks often rely on components that are one level removed from being state-of-the-art, have cases that are a bit thicker and heavier, and employ CPUs and video subsystems that aren't as fast. The exception appears to be the Compaq Contura 4/25CX, which nips at the heels of the company's more expensive LTE Lite 4/25C.

But don't dismiss the lesser-known brands. There are some good values lurking out there. Read our reviews and test analyses carefully before you proceed, and choose a company you feel will be around for several years to come.

FEATURES THAT SELL

While high performance is always desirable, you may find certain features that are more desirable than raw power. The most significant newcomer is the dual-scan screen technology and the sophisticated electronics behind it. This innovation di-

vides a screen into top and bottom halves and refreshes each independently at twice the traditional speed. The result: crisper color and less smearing or ghosting for only a marginally higher cost. Of all reviewed notebooks, only the Contura 4/25C uses this technology. The image quality produced by dual-scan technology falls midway between the quality of passive-matrix and active-matrix panels. The only downside is that there can be a visible line dividing the scanning sections—tolerable in text mode but annoying for graphics.

An increasing number of notebook systems feature built-in trackballs. None is ever as good as a real mouse, but most traveling users can tolerate the best portable pointing devices for short amounts of time. Our favorites remain the large trackball at the front of the Apple PowerBook and IBM's TrackPoint II, which looks like a pencil eraser jutting up between the G and H keys. IBM reportedly is preparing to license the technology, in part to keep other vendors from adopting copycat devices. We hope TrackPoint II holds up under long-term use. Its use of strain-gauge technology is fairly sophisticated, but the only problem we've had so far has been that the rubber nub has the tendency to fall off.

Micro Electronics deserves a kudo for coming closest to knocking off the look and feel of the PowerBook's trackball on its WinBook 486SLC/E/33. Another approach comes from Appoint (800-448-1184), which sells Gulliver, a handheld mouse that is about one-third the size of a Microsoft mouse and can be flipped over and used as a tiny trackball.

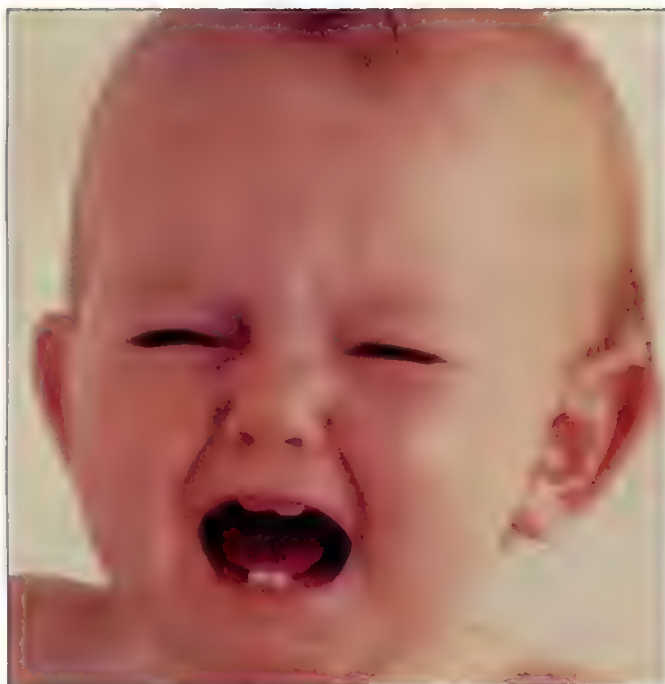
Many vendors impressed us with the inclusion of removable hard disks that let you lock away sensitive data without having to buy a bigger safe. By the same token, removable floppy disk drives can reduce the total weight of a portable by three-quarters of a pound or can make room for a second battery. Most of the major vendors offer docking stations with drive bays and expansion slots, or

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- ▶ **The Green Machine**
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- ▶ **To Protect and Serve**
May 11, 1993 Page 179

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- Up to three hours with power management (less 30 minutes with color)
- NiMH (no memory effect)
- 2200 MA with gold-plated contacts
- Worldwide auto-sensing AC adapter
- Quick 2-hour recharge

Power Management

- Eight power-saving features

Processor and Memory

- 486 SLC/E-25MHz CPU
- 4MB RAM
- 1MB ROM for AMI BIOS
- Motorola chipset and Cirrus VGA 6420
- 1k internal cache

Drives

- One built-in 1.44MB 5 1/4" floppy drive
- Internal 120MB (15ms) hard drive
- 250MB (12ms) hard drive optional

Software

- Comes loaded with MS-DOS 6.0 and Microsoft Windows 3.1

Display

- Super-twisted 64 grayscale, 10" LCD and 1024 x 768 for external monitor with 512k video RAM (simultaneous display with monochrome only)
- Optional dual-scan STN color display
- Adjustable contrast and brightness
- Visible LED indicator on cover-down

Keyboard

- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys, 3.0mm keyboard spacing

Modem

- Fax-9600 baud send/4800 baud receive/2400 baud modem

I/O Ports

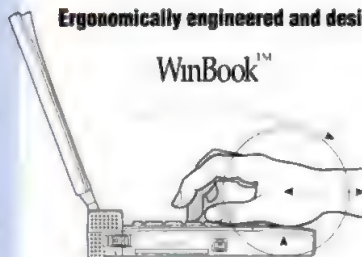
- PCMCIA 2.0 slot
- Serial: 9-pin connector
- Parallel port
- Video: 15-pin connector for CRT
- 160-pin docking station
- PS/2 mouse interface/AT keyboard interface

Options

- 250MB (12ms) hard drive
- 8MB RAM
- Coprocessor
- Docking station

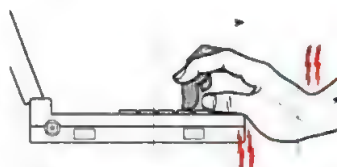
The first notebook computer designed specifically for Windows

Ergonomically engineered and designed by award-winning Palo Alto Design



The WinBook's ergonomic features include a sloping hand rest and keyboard with full-size keys, plus a dual-button trackball centered under the spacebar—allowing you to work in total comfort away from your desk.

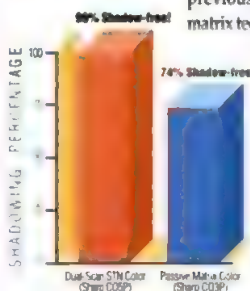
Other notebooks



Other notebook computers pay little or no attention to ergonomics—which makes basic typing an awkward task. Without a hand rest, your wrist drops to an uncomfortable angle during normal keyboard usage.

New, dual-scan STN color display gives you near active matrix quality at a passive matrix price

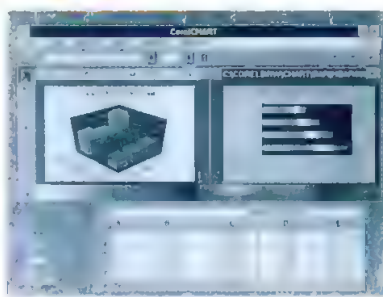
The WinBook's advanced dual-scan color display gives you 99% shadow-free performance over other passive matrix displays. You get a brighter, crisper, wider angle of view with an 18:1 contrast ratio—compared to a 13:1 contrast ratio from previous passive matrix technology.



Large, monochrome display with crisp images and less ghosting



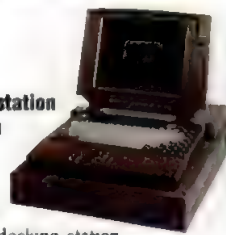
We have fine-tuned the WinBook's screen to give you a better monochrome display. Images are sharper and cleaner with less cursor loss.



WinBook features include:

- 9600 baud send/4800 baud receive fax/2400 baud modem
- Industry standard PCMCIA 2.0 slot for future expandability.
- Fast-acting LCD screen for less cursor loss.
- 512k video RAM.
- 8 power-saving features including sleep mode for all I/O ports, HDD and FDD to increase battery life.

Docking station gives you desktop power

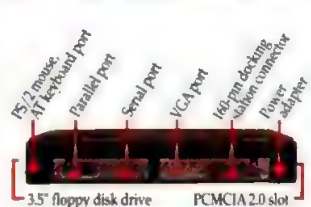


With the available docking station, your WinBook instantly becomes a full-function desktop computer. The two expansion slots and two drive bays allow you to add peripherals such as monitors, hard drives, CD ROMs I/O cards or an extended keyboard. It also includes parallel, serial, PS/2 mouse, keyboard and VGA ports. And it's just \$399!

Longer battery life

The WinBook features NiMH 2200 MA batteries with gold-plated contacts. This allows it to run much longer than units with traditional NiCAD batteries—and there's no memory effect.

Mouse/keyboard, parallel, serial and VGA ports plus PCMCIA expansion



With PCMCIA expansion you get even more flexibility with your WinBook. By sliding in credit card-size adapters, you can connect to networks, hook up an external modem, add RAM and more.



Service, warranty and support

- 72-hour service turnaround guarantee.
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- One-year limited warranty on parts and labor.
- Toll-free technical support for the life of the computer.

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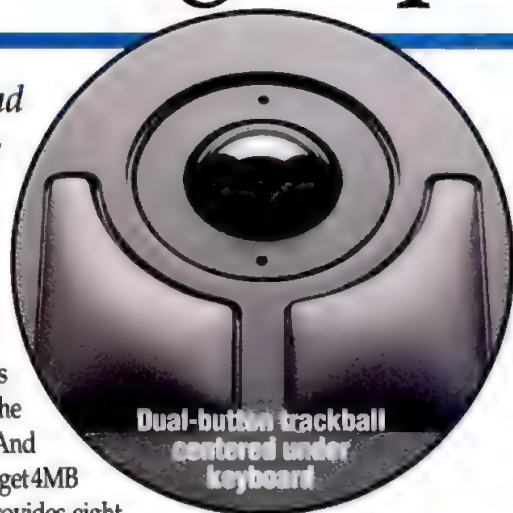
Windows at your fingertips

“The WinBook is recommended for its comfortable and efficient keyboard, trackball, and wrist rest; good battery life; and full complement of equipment at a good price.”

PC MAGAZINE, June 29, 1993 – FIRST LOOKS, Bruce Brown

The new WinBook from Micro Electronics™ gives you all the power to run Windows, and the unique design to make it easier to use.

It features a built-in, centered trackball which allows you to control cursor movements effortlessly with either thumb without having to lift a single finger off the keyboard. The impressive layout of the full-size keys and sloping palm rest lets you work in comfort. And the WinBook comes with the power and speed needed to run Windows effectively. You get 4MB memory, the new ultrafast 486 SLC/E processor and the Motorola chipset which provides eight power-saving features, even while running Windows.



The WinBook was engineered for Micro Electronics, a division of MEI/Micro Center, Inc. MEI is America's leading direct source for computer products. Micro Center has been selling PCs for more than 14 years—longer than IBM or Compaq—with over 736,000 units sold. And with over 2.2 million satisfied customers nationwide, we have developed a superior support staff, including top engineers and technical specialists. So you always get the highest quality product at the lowest possible price.

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cheaper port replicators that allow for quick cable connections in the office, or both.

The office of today relies on wires, but that may change due to a PCMCIA-based system that establishes a wireless local area network. Made by Proxim (415-960-1630), the product is called RangeLAN/PCMCIA and can be purchased as separate cards or bundled with a desktop base station from AST Research. The system uses spread-spectrum radio frequency transmitters to make contact through Windows for Workgroups in the AST version; other variations support NetWare or Microsoft LAN Manager. While Proxim claims its product works for distances of 300 to 500 feet indoors and up to 800 feet in the open, our anecdotal tests showed that it worked reliably up to about 100 feet in our office, which is criss-crossed with interfering wires and steel girders. Don't expect the data throughput of a wired network connection because the RangeLAN system can pump data only at the rate of 242 kilobits per second (Kbps).

A whole industry has arisen around specialty notebook accessories. For example, if your notebook's hard disk is rapidly filling up, consider an upgrade that could take you as high as 340MB for many popular Compaq or Toshiba notebooks. Laptop Solutions of Houston, Texas (713-789-0878) will install a new hard disk overnight and even transfer your files onto the new disk. But at \$1,500, this extra headroom is not cheap.

On the other hand, an external hard disk with removable media might do the trick if it were light and battery-operated. SyDOS of Boca Raton, Florida (800-437-9367) sells a 1.5-pound unit called the Pro*Note that holds 42MB and interfaces via the notebook's parallel port. This product gets power from nickel cadmium cells that last for about 2 hours of real-world use. While data transfer is slower than with an internal drive or through an expansion port, the Pro*Note is useful for making backups or for storing very large data sets.

Among the systems we tested, several had a special bent. The NEC Versa and the GRiD Convertible can double as pen computers. By contrast, the Canon NoteJet 486 (see the sidebar "Canon NoteJet

What the Numbers Mean

Of the 68 portable systems we review here, 20 processors are represented, with CPUs ranging from mid-level 386 chips to high-end 486s. While the best systems were able to approach the performance of average desktop personal computers, having the fastest chip wasn't always the ticket to the computing fast lane.

PROCESSOR AND MEMORY

Rapidly advancing processor technology and the proliferation of chips are seen in the diversity of CPUs found in this review. The computer industry's newest portable systems rely on various versions of 486 processors. Although in this issue we introduce our first batch of 486DX2/66-based notebooks, we find that the fastest processor does not always produce the best system. For example, the TI TravelMate 4000 WinDX2/50 continues to be the top gun of the portable world, outperforming several DX2/66-based systems. The 4000 WinDX2/50 performed 12,568 processor operations per second and handled 8,467 kilobytes per second (KBps) on our memory tests. This is 13 percent better in terms of the processor score and 10 percent better in terms of the memory score than the average 486DX2/66 achieved in this roundup. The TI TravelMate 4000 WinDX2/40 also stood out, sporting Intel's new 486DX2/40 CPU. It scored 10,070 processor operations per second and 6,746 KBps on the memory tests, making it one of the top ten processor and memory performers we reviewed.

Intel's 25-MHz 486SL CPU appears to be the fastest-growing processor class for portables. The use of this chip rose from a handful in our last portables roundup to 11 in this article, second only to the number of notebooks using the 386SL CPU. The NEC UltraLite Versa 25C led the 486SLs, with a processor score of 6,165 operations per second.

At the other performance extreme are the lower-order 486 processor types, including the seven systems

based on the Cyrix 486SLC/25 CPU. The Hyundai Courier Spectra ranked first in its processor category and ranked 44th overall. The Epson Action-Note 4SLC/25 produced the slowest processor score among the Cyrix-based machines, which is attributable to the Epson's poor memory subsystem. The only 486SLC/E-33 in this roundup is the Micro Electronics WinBook 486SLC/E/33. Of all tested systems it ranked 41st in processor testing, at 4,480 operations per second, and 17th in memory, at 4,740 kilobytes per second.

HyperData Technology Corp.'s Hyperbook 2300 DLC/40 uses the Cyrix 486DLC/40 CPU and is one of the few systems with a fairly large external memory cache. It scored tenth on processor and memory tests, due in part to its 128K of external cache.

Leading the pack among 386SL/25 units was the Compaq LTE Lite 25E, performing 3,186 processor operations per second. At the bottom of this CPU group is the AST PowerExec EL Color, performing 2,409 processor operations per second, and the Zeos Contenda sub-notebook, performing 2,759 processor operations per second. These units suffered a performance penalty because both lacked external processor caches. By contrast, the systems powered by the 386SX/25 CPU did slightly better. The Toshiba Satellite T1850C, a 386SX/25-based unit, performed 2,692 processor operations per second and 3,432K per second on the memory tests.

The CAF AquaLITE II and the Hyundai Courier were the only two systems using the AMD386SXL/25 CPU. The average processor performance of

these two non-L2 cache systems was slightly better than that of the two non-L2 cache Intel 386SL/25 units (the AST PowerExec EL Color and the Zeos Contenda). The ZDS Z-Sport 425S and the Mitsuba Ninja 486SX/25 tracked below average in memory performance, ranking fifth and sixth among the 486SX/25-based units.

DOS VIDEO

Two systems were able to rise above the pack in terms of DOS video operations, each breaking the 4-million-operation-per-second barrier for notebooks. The DECpc 425SL, which employs Western Digital's WD90C26 chip set, yielded 4.17 million operations per second, and the IBM ThinkPad 720C, using proprietary electronics, handled 4.06 million operations per second. The NEC Ultra-Lite Versa 25C is unique in featuring a local-bus video implementation but was slightly behind the pack, at 3.89 million video operations per second.

Once again, the top video performers were the active-matrix color units, an indication that screen technology remains the limiting factor in video performance. Out of the 12 active color units, 6 were in the top 10.

DOS DISK

Toshiba's MK-2224FC hard disk led the pack in a variety of implementations. The Twinhead Slimnote DX2/66T, with its 128K of on-board hardware cache, led the group, scoring 35.56K per second (KBps). This was followed closely by the Blue Star 486DX2/66, the HyperBook 2300DX2/50, and the Compudyne 4DX2/66 Monochrome Slimnote, all of which scored well over 30 KBps. On the other side of the spectrum, the ZDS Z-Lite 320L, using a 60MB Seagate 908A drive, scored only 14.13 KBps.

DOSMARK

The DOSmark score combines all of the DOS scores and heavily weights each system's disk performance. Here again, Toshiba's MK-2224FC hard disk excelled, particularly in the Compudyne 4DX2/66 Active TFT Color Slimnote, which had a DOSmark score of over 35.

GRAPHICS WINMARK

Nine out of the top ten Graphics Winmark performers were based on the Intel 486 designs. The exception, the IBM ThinkPad 720C, uses an SLC/2 CPU and a proprietary IBM video chip set; it ranked first, with a Graphics Winmark score of over 5 megapixels per second. The NEC Versa was the only system in this roundup to use local-bus technology; utilizing a Chips & Technologies 65530 chip set, the Versa came in second, with a Graphics Winmark score of nearly 4.5 megapixels per second.

DISK WINMARK

For this portion of the testing, we configured each system with a fixed 1MB of SmartDrive cache to represent a Windows setup for a system with 4MB of system RAM. With the exception of the Blue Star 486DX2/66, GRiD Convertible, and Samsung NoteMaster 486SLC Model S3800 (at 8MB) and the ZDS Z-Lite 320L (at 6MB), all other systems were tested with 4MB of system RAM. The units with 6MB and above could not be depopulated in order to keep within the 4MB filter. All of the top Disk Winmark performers were on the higher end of the 486 processor scale. The Tenex 486DX/33 Chroma—which ranked third, with a Disk Winmark score of 35.99 KBps—is the only unit among the top ten that does not use clock-doubling technology.

WINDOWS APPLICATIONS

For this issue, we ran the Windows Applications suite for the first time on portable PCs. This test suite uses four popular Windows programs running serially. We found that the overall results mirrored processor type and disk performance, as reflected in a nearly four-fold difference between the best and the worst systems. The top five performers were the Twinhead Slimnote 4DX2/66T, the Blue Star 486DX2/66, HyperData Technology Corp.'s HyperBook 2300DX2/50, the Compudyne 4DX2/66 Active TFT Color Slimnote, and the Compudyne 4DX2/66 Monochrome Slimnote.

How We Tested

We used PC Magazine Labs' Hardware Benchmark Tests, Release 7.01, to predict processor, memory, video, and disk performance using DOS applications. Each of the four scores we report is the weighted harmonic mean of the results from several tests. These results are summarized in a composite score called the DOSmark that estimates system performance. We also used the Windows Benchmark Tests (Winbench), Release 3.11, to obtain the Graphics Winmark and Disk Winmark scores, and used the Windows Applications tests to simulate a multitasking environment.

The **processor** score is a measure of the CPU's performance and its interaction with cache and main memory. It uses small and medium-size instruction mixes, along with either the floating-point calculation test or the coprocessor test (depending on the availability of a math coprocessor).

The **memory** score is compiled from 8-, 16-, and 32-bit extended-memory read and write tests, as well as 8- and 16-bit conventional-memory read and write tests.

The **disk** score measures throughput using standard DOS INT 21h file I/O calls. The tests measure the speed of file reading and writing, both sequentially and randomly, for a range of file sizes from 256K to 32MB. The tests are performed without software disk caches installed.

The **video** score is based on direct-to-screen text-write and graphics-write tests.

The **DOSmark** score is a composite rating derived from the processor, memory, video, and disk scores. It indicates a PC's ability to run DOS applications.

The **Graphics Winmark** score is based on 12 Windows graphics and text functions that are derived from extensive profiling of popular Windows applications. This score is measured in megapixels per second (a megapixel is 1,048,576 pixels).

The **Disk Winmark** score reflects disk operations in the Windows environment. Systems are configured with up to 2MB of SmartDrive software cache.

In the **Windows Applications** suite, portions of four programs—Ami Pro, Core!DRAW, Microsoft Excel, and Superbase—are run via a macro and are timed. Because the results are given in seconds, lower scores represent better performance.

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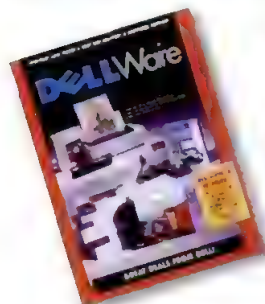
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Benchmark Tests: Portable PCs

PROCESSOR

Operations per second	0	5,000	10,000	
AST PowerExec EL Color (i386SL/25)				2,409
AST PowerExec 3/25SL Color (i386SL/25)				3,032
AST PowerExec 4/25SL Color Plus (i486SL/25)				5,955
Aurum GoldNote DX2 50 (i486DX2/50)				9,353
Blue Star 486SX/66 (i486SX/66)				11,115
CAF AquaLite II (i386SL/25)				2,790
Compaq Contura 4/25 (i486SL/25)				5,797
Compaq Contura 4/25C (i486SL/25)				5,783
Compaq Contura 4/25SX (i486SL/25)				5,797
Compaq LTE Lite 25C (i486SL/25)				3,186
Compaq LTE Lite 25 (i486SL/25)				5,217
CompuAdd Express 425Color (i486SLC/25)				3,318
CompuAdd Express 425ColorPlus (i486SLC/25)				3,322
CompuAdd Express 425XL (i486SLC/25)				3,315
Compudyne Color Slimnote (i486DX2/66)				11,203
Compudyne Monochrome Slimnote (i486DX2/66)				11,188
Compudyne 4SL/25 Subnote (i486SL/25)				2,826
Dell NoteLite 25 (i386SL/25)				3,171
Dell NoteLite 25C (i486SL/25)				3,170
Dell NoteLite 25SX (i486SL/25)				3,117
Dell NoteLite 25CXL (i486SL/25)				3,117
Digital DECpc 325SL (i386SL/25)				3,011
Digital DECpc 325SLC (i386SL/25)				3,038
Digital DECpc 425SL (i486SL/25)				3,032
Digital DECpc 425SLC (i486SL/25)				5,953
Epson ActionNote 4SLC/25 (i486SLC/25)				2,991
Ergo PowerBook 440 (i486DX/33)				6,552
Gateway Nomad 425SLX (i486SX/25)				6,821
Gateway Nomad 450DXL (i486DX2/50)				12,568
GRiD Convertible (i386SL/25)				2,977
HyperBook 2300DX/50 (i486DX/50)				8,628
HyperBook 2300DX/50 (i486DX/50)				11,727
Hyundai Courier ApolloXL/25				2,730
Hyundai Courier Spectra (i486SLC/25)				3,466
IBM ThinkPad 720C (i486SLC/2)				6,543
Jetta Jetbook 486DX/33 (i486DX/33)				7,038
Micro Electronics WinBook (i486SLC/25)				4,480
Micro Express NP943 Notebook PC (i486DX/33)				6,941
Minolta Noma 486SX/25 (i486SX/25)				5,283
NEC UltraLite Versa 25C (i486SL/25)				6,165
Packard Bell 486DX/25 Notebook (i486DX/25)				5,770
PC Brand Color LeaderBook Pro (i486DX/33)				6,532
Poly NB325V (i386SL/25)				3,099
Poly NB425C (i486SLC/25)				3,206
Samsung NoteMaster Model S3800 (i486SLC/25)				3,357
Santron 486 Jetbook (i486DX/33)				6,953
Tenex 486SLC/25 (i486SLC/25)				3,757
Tenex 486DX/33 Chroma (i486DX/33)				6,941
Ti WinSLC 25 (i486SLC/25)				3,649
Ti 4000 WinDX/25 (i486DX/25)				6,327
Ti 4000 WinDX2/40 Color (i486DX2/40)				10,070
Ti 4000 WinDX2/50 (i486DX2/50)				12,568
Ti 4000 WinSX/25 (i486SX/25)				6,821
Ti 4000 WinSX/25 Color (i486SX/25)				6,810
Toshiba Satellite T1850C (i386SX/25)				2,692
Toshiba T4400C (i486DX/25)				6,858
Toshiba T4500 (i486SX/20)				5,005
Toshiba T4500C (i486SX/20)				5,030
Toshiba T4500C (i486SX/20)				7,783
Twinhead Slimnote 4DX/33T (i486DX/33)				11,178
Twinhead Slimnote 4DX/66T (i486DX2/66)				7,679
ZDS Z Lite 320L (i386SL/20)				2,051
ZDS Z Note 425Inc Model 120 (i486SL/25)				5,957
ZDS Z Note 425Inc Model 200 (i486SL/25)				5,955
ZDS Z Note 425Inc Model 120 (i486SL/25)				5,957
ZDS Z Sport 420S (i487SX/20)				4,886
ZDS Z Sport 425S (i487SX/25)				6,127
Zeos Contenda (i386SL/25)				2,759

WORST

BEST

MEMORY

Kilobytes per second	0	1,000	6,000	
AST PowerExec EL Color (i386SL/25)				2,700
AST PowerExec 3/25SL Color (i386SL/25)				2,828
AST PowerExec 4/25SL Color Plus (i486SL/25)				4,189
Aurum GoldNote DX2 50 (i486DX2/50)				6,143
Blue Star 486DX2/66 (i486DX2/66)				7,287
CAF AquaLite II (i386SL/25)				3,133
Compaq Contura 4/25 (i486SL/25)				4,224
Compaq Contura 4/25C (i486SL/25)				4,219
Compaq Contura 4/25SX (i486SL/25)				4,219
Compaq LTE Lite 25C (i486SL/25)				2,992
Compaq LTE Lite 25 (i486SL/25)				3,814
CompuAdd Express 425Color (i486SLC/25)				3,496
CompuAdd Express 425ColorPlus (i486SLC/25)				3,514
CompuAdd Express 425XL (i486SLC/25)				3,514
Compudyne Color Slimnote (i486DX2/66)				7,832
Compudyne Monochrome Slimnote (i486DX2/66)				7,832
Compudyne 4SL/25 Subnote (i486SL/25)				3,522
Dell NoteLite 25 (i386SL/25)				2,784
Dell NoteLite 25C (i486SL/25)				2,786
Dell NoteLite 25SX (i486SL/25)				3,029
Dell NoteLite 25CXL (i486SL/25)				3,029
Digital DECpc 325SL (i386SL/25)				3,029
Digital DECpc 325SLC (i386SL/25)				2,829
Digital DECpc 425SL (i486SL/25)				4,184
Epson ActionNote 4SLC/25 (i486SLC/25)				3,072
Ergo PowerBook 440 (i486DX/33)				4,570
Gateway Nomad 425SLX (i486SX/25)				4,628
Gateway Nomad 450DXL (i486DX2/50)				8,420
GRiD Convertible (i386SL/25)				2,784
HyperBook 2300DX/50 (i486DX/50)				5,628
HyperBook 2300DX/50 (i486DX/50)				6,734
Hyundai Courier ApolloXL/25				3,029
Hyundai Courier Spectra (i486SLC/25)				3,570
IBM ThinkPad 720C (i486SLC/2)				4,019
Jetta Jetbook 486DX/33 (i486DX/33)				5,149
Micro Electronics WinBook (i486SLC/25)				4,740
Micro Express NP943 Notebook PC (i486DX/33)				5,087
Minolta Noma 486SX/25 (i486SX/25)				3,957
NEC UltraLite Versa 25C (i486SL/25)				4,236
Packard Bell 486DX/25 Notebook (i486DX/25)				4,084
PC Brand Color LeaderBook Pro (i486DX/33)				4,570
Poly NB325V (i386SL/25)				2,788
Poly NB425C (i486SLC/25)				3,519
Samsung NoteMaster Model S3800 (i486SLC/25)				3,555
Santron 486 Jetbook (i486DX/33)				5,034
Tenex 486SLC/25 (i486SLC/25)				3,853
Tenex 486DX/33 Chroma (i486DX/33)				5,087
Ti WinSLC 25 (i486SLC/25)				3,714
Ti 4000 WinDX/25 (i486DX/25)				4,654
Ti 4000 WinDX2/40 Color (i486DX2/40)				6,746
Ti 4000 WinDX2/50 (i486DX2/50)				8,467
Ti 4000 WinSX/25 (i486SX/25)				4,654
Ti 4000 WinSX/25 Color (i486SX/25)				4,628
Toshiba Satellite T1850C (i386SX/25)				3,432
Toshiba T4400C (i486DX/25)				4,364
Toshiba T4500 (i486SX/20)				3,110
Toshiba T4500C (i486SX/20)				3,113
Twinhead Slimnote 4DX/33T (i486DX/33)				5,478
Twinhead Slimnote 4DX/66T (i486DX2/66)				7,800
ZDS Z Lite 320L (i386SL/20)				2,314
ZDS Z Note 425Inc Model 120 (i486SL/25)				4,189
ZDS Z Note 425Inc Model 200 (i486SL/25)				4,189
ZDS Z Note 425Inc Model 120 (i486SL/25)				4,189
ZDS Z Sport 420S (i487SX/20)				3,406
ZDS Z Sport 425S (i487SX/25)				4,261
Zeos Contenda (i386SL/25)				2,941

WORST

BEST

VIDEO

Millions of operations per second	0	1	2	3	4	
AST PowerExec EL Color (i386SL/25)						1.86
AST PowerExec 3/25SL Color (i386SL/25)						3.87
AST PowerExec 4/25SL Color Plus (i486SL/25)						2.22
Aurum GoldNote DX2 50 (i486DX2/50)						0.87
Blue Star 486DX2/66 (i486DX2/66)						1.88
CAF AquaLITE II (i386SL/25)						2.82
Compaq Contura 4/25 (i486SL/25)						2.77
Compaq Contura 4/25C (i486SL/25)						2.84
Compaq Contura 4/25CX (i486SL/25)						2.94
Compaq LTE Lite 25E (i386SL/25)						2.81
Compaq LTE Lite 4/25C (i486SL/25)						2.83
CompuAdd Express 425Color (Cx486SLC/25)						1.86
CompuAdd Express 425ColorPlus (Cx486SLC/25)						2.81
CompuAdd Express 425XL (Cx486SLC/25)						1.88
Compudyne Color Slimnote (i486DX2/66)						2.31
Compudyne Monochrome Slimnote (i486DX2/66)						2.29
Compudyne 4S, 25 Subnote (i486SL/25)						1.74
Dell NL25 (i386SL/25)						0.52
Dell NL25C (i386SL/25)						1.85
Dell 325N (i386SL/25)						1.24
Dell 325NC (i386SL/25)						1.26
Dell 325SL (i386SL/25)						2.85
Digital DECpc 325SL (i386SL/25)						3.83
Digital DECpc 325SLC (i386SL/25)						3.86
Digital DECpc 425SL (i486SL/25)						4.17
Epson ActionNote 4S, C 25 (Cx486SLC/25)						1.88
Ergo PowerBrick 486 (i486DX/33)						2.85
Gateway Nomad 425SL (i486SL/25)						1.81
Gateway Nomad 450DX (i486DX2/50)						1.88
GRiD Convertible (i386SL/25)						1.79
HyperBook 2300DLC/40 (Cx486DLC/40)						2.13
HyperBook 2300DX2 50 (i486DX2/50)						2.28
Hyundai Courier (i386SL/25)						1.86
Hyundai Courier Spectra (Cx486SLC/25)						1.20
IBM ThinkPad 720C (i486SLC/25)						4.06
Jetta Jetbook 486DX 33 (i486DX/33)						1.91
Micro Electronics WinBook (Cx486SLC/E/33)						2.11
Micro Express NP943 Notebook PC (i486DX/33)						1.15
Mitsuba Ninja 486SX 25 (i486SX/25)						1.88
NEC UltraLite Versa 25C (i486SL/25)						3.88
Packard Bell 486DX 25 Notebook (i486DX/25)						1.88
PC Brand Color LeaderBook Pro (i486DX/33)						3.36
Poly NB325V (i386SL/25)						1.86
Poly NB425C (Cx486SLC/25)						1.82
Samsung NoteMaster Mode S3800 (Cx486SLC/25)						1.82
Santron 486 Jetbook (i486DX/33)						1.44
Tenex 486SLC/25 (i486SLC/25)						0.98
Tenex 486DX/33 Chroma (i486DX/33)						1.19
TI WinSLC 25 (i486SLC/25)						1.13
TI 4000 WinDX 25 (i486DX/25)						2.09
TI 4000 WinDX 40 Color (i486DX2/40)						1.85
TI 4000 WinDX2/50 (i486DX2/50)						2.12
TI 4000 WinSX 25 (i486SX/25)						2.08
TI 4000 WinSX 25 Color (i486SX/25)						1.86
Toshiba Satellite T1850C (i386SL/25)						3.81
Toshiba T4400C (i486DX/25)						3.13
Toshiba T4500 (i486SX/20)						2.96
Toshiba T4500C (i486SX/20)						3.19
Twinhead Slimnote 4DX/33T (i486DX/33)						2.36
Twinhead Slimnote 4DX2/66T (i486DX2/66)						2.31
Twinhead Slimnote 4SX/33M (i486SX/33)						1.81
ZDS Z-Lite 320L (i386SL/20)						1.85
ZDS Z-Note 425Ln Model 120 (i486SL/25)						3.43
ZDS Z-Note 425Ln Model 200 (i486SL/25)						3.83
ZDS Z-Note 425Lnp Model 120 (i486SL/25)						3.43
ZDS Z-Sport 420S (i487SX/20)						0.84
ZDS Z-Sport 425S (i487SX/25)						0.88
Zeos Contenda (i386SL/25)						1.83

WORST

BEST

DISK

Kilobytes per second	0	10	20	30	
AST PowerExec EL Color (i386SL/25)					17.78
AST PowerExec 3/25SL Color (i386SL/25)					25.96
AST PowerExec 4/25SL Color Plus (i486SL/25)					27.28
Aurum GoldNote DX2 50 (i486DX2/50)					20.74
Blue Star 486DX2/66 (i486DX2/66)					35.10
CAF AquaLITE II (i386SL/25)					16.11
Compaq Contura 4/25 (i486SL/25)					16.40
Compaq Contura 4/25C (i486SL/25)					16.00
Compaq Contura 4/25CX (i486SL/25)					16.46
Compaq LTE Lite 25E (i386SL/25)					18.12
Compaq LTE Lite 4/25C (i486SL/25)					22.67
CompuAdd Express 425Color (Cx486SLC/25)					19.76
CompuAdd Express 425ColorPlus (Cx486SLC/25)					23.17
CompuAdd Express 425XL (Cx486SLC/25)					19.74
Compudyne Color Slimnote (i486DX2/66)					35.36
Compudyne Monochrome Slimnote (i486DX2/66)					34.86
Compudyne 4S, 25 Subnote (i486SL/25)					16.40
Dell NL25 (i386SL/25)					15.77
Dell NL25C (i386SL/25)					16.54
Dell 325N (i386SL/25)					23.79
Dell 325NC (i386SL/25)					22.33
Dell 325SL (i386SL/25)					27.22
Digital DECpc 325SL (i386SL/25)					15.44
Digital DECpc 325SLC (i386SL/25)					15.54
Digital DECpc 425SL (i486SL/25)					16.90
Epson ActionNote 4S, C 25 (Cx486SLC/25)					26.25
Ergo PowerBrick 486 (i486DX/33)					26.22
Gateway Nomad 425SL (i486SL/25)					22.11
Gateway Nomad 450DX (i486DX2/50)					27.68
GRiD Convertible (i386SL/25)					15.31
HyperBook 2300DLC/40 (Cx486DLC/40)					35.06
HyperBook 2300DX2 50 (i486DX2/50)					35.06
Hyundai Courier (i386SL/25)					15.03
Hyundai Courier Spectra (Cx486SLC/25)					25.23
IBM ThinkPad 720C (i486SLC/25)					22.13
Jetta Jetbook 486DX 33 (i486DX/33)					28.42
Micro Electronics WinBook (Cx486SLC/E/33)					23.52
Micro Express NP943 Notebook PC (i486DX/33)					21.27
Mitsuba Ninja 486SX 25 (i486SX/25)					16.24
NEC UltraLite Versa 25C (i486SL/25)					20.73
Packard Bell 486DX 25 Notebook (i486DX/25)					20.64
PC Brand Color LeaderBook Pro (i486DX/33)					20.23
Poly NB325V (i386SL/25)					15.44
Poly NB425C (Cx486SLC/25)					20.31
Samsung NoteMaster Mode S3800 (Cx486SLC/25)					20.39
Santron 486 Jetbook (i486DX/33)					19.46
Tenex 486SLC/25 (i486SLC/25)					30.39
Tenex 486DX/33 Chroma (i486DX/33)					34.21
TI WinSLC 25 (i486SLC/25)					17.69
TI 4000 WinDX 25 (i486DX/25)					22.88
TI 4000 WinDX 40 Color (i486DX2/40)					28.86
TI 4000 WinDX2/50 (i486DX2/50)					27.99
TI 4000 WinSX 25 (i486SX/25)					21.38
TI 4000 WinSX 25 Color (i486SX/25)					19.67
Toshiba Satellite T1850C (i386SL/25)					15.23
Toshiba T4400C (i486DX/25)					32.96
Toshiba T4500 (i486SX/20)					18.52
Toshiba T4500C (i486SX/20)					19.63
Twinhead Slimnote 4DX/33T (i486DX/33)					32.50
Twinhead Slimnote 4DX2/66T (i486DX2/66)					35.96
Twinhead Slimnote 4SX/33M (i486SX/33)					21.54
ZDS Z-Lite 320L (i386SL/20)					14.13
ZDS Z-Note 425Ln Model 120 (i486SL/25)					22.89
ZDS Z-Note 425Ln Model 200 (i486SL/25)					27.27
ZDS Z-Note 425Lnp Model 120 (i486SL/25)					22.60
ZDS Z-Sport 420S (i487SX/20)					25.49
ZDS Z-Sport 425S (i487SX/25)					17.11
Zeos Contenda (i386SL/25)					15.67

WORST

BEST

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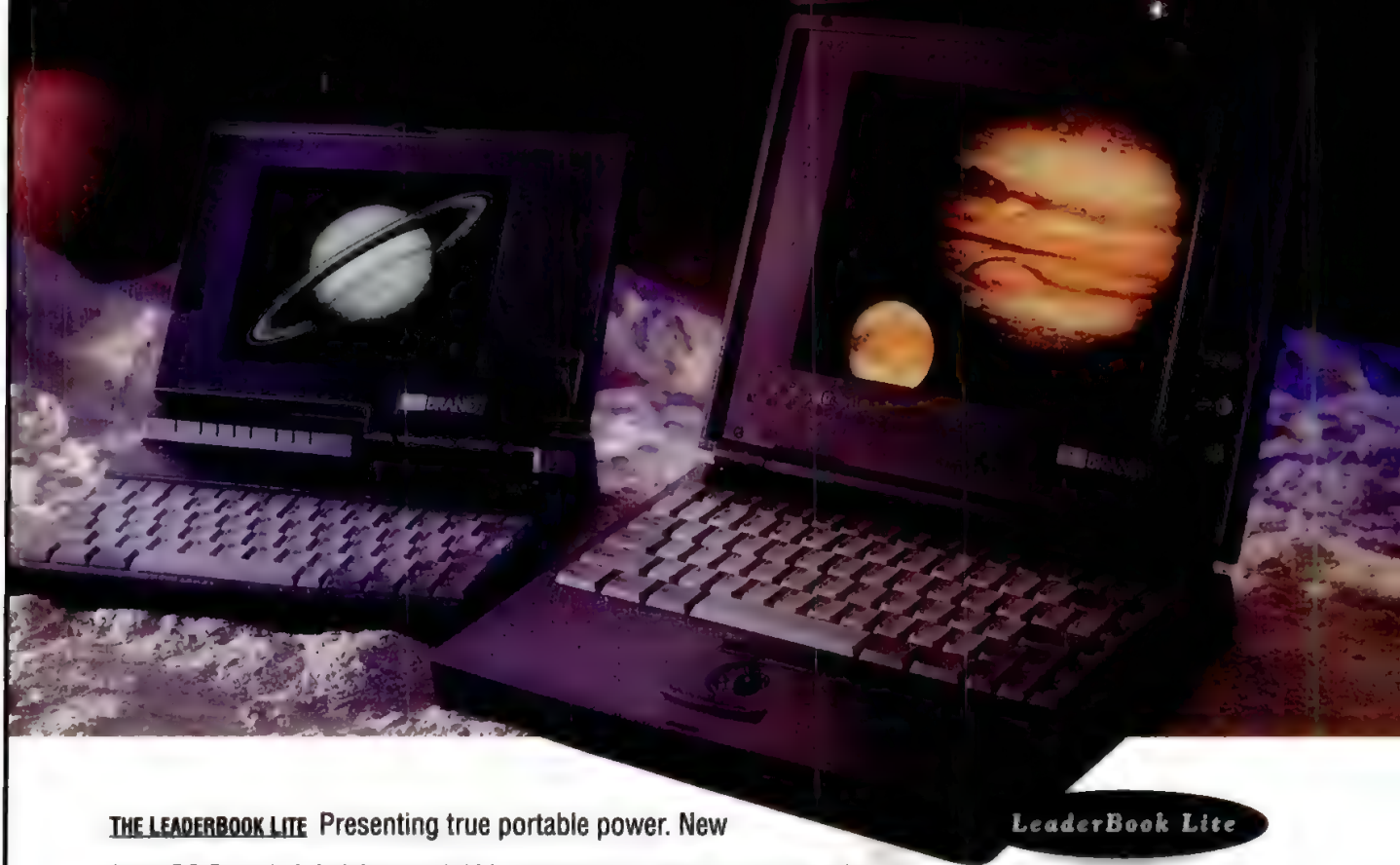
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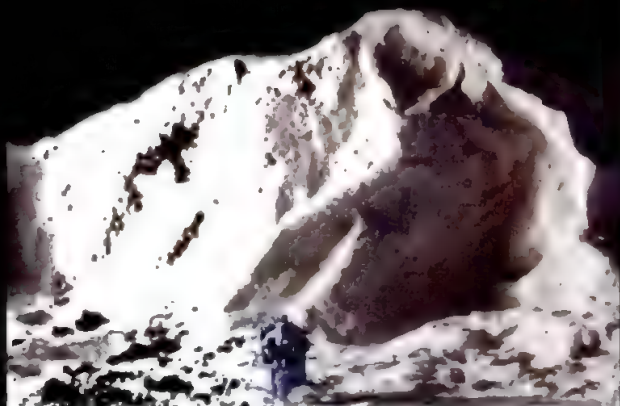
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Specifications

Leader VLB	386/SX-33	486SX/25	486DX/33 VLB	486DX2/50 VLB	486DX2/66 VLB
Processor Upgradable			●	●	●
Memory/Cache	2MB	4MB/128k	4MB/128k	4MB/128k	4MB/128k
Hard Drive	105MB	105MB	170MB	170MB	170MB
Windows Accelerator		Yes/1MB	Yes/1MB	Yes/1MB	Yes/1MB
1.44MB FDD	●	●	●	●	●
1.2MB FDD			●	●	●
32 Bit VESA Local Bus Slots		Yes/2	Yes/2	Yes/2	Yes/2
14" 1024x768 Monitor	●	●	●	●	●
Mini Desktop Case	●	●	●	●	●
RAM Expandable to 32MB	●	●	●	●	●
Write through RAM cache expands to 256K	●	●	●	●	●
101-Key Keyboard	●	●	●	●	●
Serial Mouse	●	●	●	●	●
MS-DOS 6 & Windows	●	●	●	●	●
CompuServe	●	●	●	●	●
Toll-Free Technical Support	●	●	●	●	●
One Year Limited Warranty	●	●	●	●	●
30-Day Money Back Guarantee	●	●	●	●	●
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Benchmark Tests: Portable PCs

DOSMARK

	0	10	20	30	
AST PowerExec EL Color (i386SL/25)					13.33
AST PowerExec 3/25SL Color (i386SL/25)					17.42
AST PowerExec 4/25SL Color Plus (i486SL/25)					23.97
Aurum GoldNote DX2-50 (i486DX2/50)					23.28
Blue Star 486DX2/66 (i486DX2/66)					35.30
CAF AquaLITE II (A386SL/25)					13.68
Compaq Contura 4/25 (i486SL/25)					17.53
Compaq Contura 4/25C (i486SL/25)					17.23
Compaq Contura 4/25CX (i486SL/25)					17.98
Compaq LTE Lite 25E (i386SL/25)					15.12
Compaq LTE Lite 4/25C (i486SL/25)					20.96
CompuAdd Express 425Color (Cx486SLC/25)					16.35
CompuAdd Express 425ColorPlus (Cx486SLC/25)					17.72
CompuAdd Express 425XL (Cx486SLC/25)					16.35
Compudyn Color Slimnote (i486DX2/66)					35.96
Compudyn Monochrome Slimnote (i486DX2/66)					35.62
Compudyn 4SL/25 Subnote (i486SL/25)					14.04
Dell NL25 (i386SL/25)					13.67
Dell NL25C (i386SL/25)					14.20
Dell 325N (i386SL/25)					17.05
Dell 325N/C (i386SL/25)					16.57
Dell 325SL (i386SL/25)					17.89
Digital DEcpc 325SL (i386SL/25)					13.57
Digital DEcpc 325SLC (i386SL/25)					13.61
Digital DEcpc 425SL (i486SL/25)					17.99
Epson ActionNote 4SL/25 (Cx486SLC/25)					17.61
Ergo PowerBook 486 (i486DX/33)					24.42
Gateway Nomad 425SL (i486SL/25)					22.23
Gateway Nomad 450DX (i486DX/50)					31.41
GRiD Convertible (i386SL/25)					13.36
HyperBook 2300DC (C40/Cx486DC/40)					30.22
HyperBook 2300DX (C50/Cx486DX/50)					35.36
Hyundai Courier (A386SL/25)					13.00
Hyundai Courier Spectra (Cx486SLC/25)					18.70
IBM ThinkPad 720C (BM486SLC/2)					21.68
Jetta Jetbook 486DX/33 (i486DX/33)					26.47
Micro Electronics WinBook (Cx486SLC/E/33)					20.64
Micro Express NP943 Notebook PC (i486DX/33)					21.94
Mitsuba Ninja 486SL/25 (i486SL/25)					16.90
NEC UltraLite Versa 25C (i486SL/25)					20.69
Packard Bell 486DX/25 Notebook (i486DX/25)					20.13
PC Brand Color LeaderBook Pro (i486DX/33)					20.05
Poly NB325V (i386SL/25)					13.55
Poly NB425C (Cx486SLC/25)					16.40
Samsung NoteMaster Model S3800 (Cx486SLC/25)					16.72
Santron 486 Jetbook (i486DX/33)					20.74
Tenex 486SLC/25 (i486SLC/25)					20.93
Tenex 486SL/33 Chroma (i486DX/33)					28.99
Ti WinSLC/25 (i486SL/25)					15.96
Ti 4000 WinDX/25 (i486DX/25)					22.83
Ti 4000 WinDX/25 Color (i486DX/25)					30.18
Ti 4000 WinDX/25 (i486DX/25)					31.73
Ti 4000 WinDX/25 (i486DX/25)					31.80
Ti 4000 WinDX/25 (i486DX/25)					31.73
Ti 4000 WinDX/25 (i486DX/25)					20.63
Toshiba Satellite T1850C (i386SL/25)					13.26
Toshiba T4400C (i486DX/25)					27.63
Toshiba T4500 (i486SL/20)					17.53
Toshiba T4500C (i486SL/20)					18.17
Twinhead Slimnote 4DX/33T (i486DX/33)					36.05
Twinhead Slimnote 4SL/33M (i486SL/33)					22.93
Twinhead Slimnote 4DX/33T (i486DX/33)					25.69
ZDS Z Lite 320L (i386SL/20)					11.00
ZDS Z Note 425SLC Model 120 (i486SL/25)					21.75
ZDS Z Note 425SLC Model 200 (i486SL/25)					24.03
ZDS Z Note 425SLC Model 120 (i486SL/25)					21.59
ZDS Z Sport 425C (i487SL/20)					22.30
ZDS Z Sport 425C (i487SL/20)					18.08
Zeos Contenda (i386SL/25)					13.29

WORST

BEST

GRAPHICS WINMARK

	Megapixels per second	0	1	2	3	4	5	
AST PowerExec EL Color (i386SL/25)								1.52
AST PowerExec 3/25SL Color (i386SL/25)								1.90
AST PowerExec 4/25SL Color Plus (i486SL/25)								3.41
Aurum GoldNote DX2-50 (i486DX2/50)								2.10
Blue Star 486DX2/66 (i486DX2/66)								3.06
CAF AquaLITE II (A386SL/25)								1.73
Compaq Contura 4/25 (i486SL/25)								2.14
Compaq Contura 4/25C (i486SL/25)								2.16
Compaq Contura 4/25CX (i486SL/25)								2.16
Compaq LTE Lite 25E (i386SL/25)								1.43
Compaq LTE Lite 4/25C (i486SL/25)								1.86
CompuAdd Express 425Color (Cx486SLC/25)								1.35
CompuAdd Express 425ColorPlus (Cx486SLC/25)								1.67
CompuAdd Express 425XL (Cx486SLC/25)								1.67
Compudyn Color Slimnote (i486DX2/66)								3.53
Compudyn Monochrome Slimnote (i486DX2/66)								3.51
Compudyn 4SL/25 Subnote (i486SL/25)								1.89
Dell NL25 (i386SL/25)								1.01
Dell NL25C (i386SL/25)								1.61
Dell 325N (i386SL/25)								1.51
Dell 325N/C (i386SL/25)								1.51
Dell 325SL (i386SL/25)								1.89
Digital DEcpc 325SL (i386SL/25)								1.84
Digital DEcpc 325SLC (i386SL/25)								1.85
Digital DEcpc 425SL (i486SL/25)								3.39
Epson ActionNote 4SL/25 (Cx486SLC/25)								1.78
Ergo PowerBook 486 (i486DX/33)								3.41
Gateway Nomad 425SL (i486SL/25)								2.15
Gateway Nomad 450DX (i486DX/50)								2.67
GRiD Convertible (i386SL/25)								1.55
HyperBook 2300DC (C40/Cx486DC/40)								2.47
HyperBook 2300DX (C50/Cx486DX/50)								3.53
Hyundai Courier (A386SL/25)								1.63
Hyundai Courier Spectra (Cx486SLC/25)								1.79
IBM ThinkPad 720C (BM486SLC/2)								5.05
Jetta Jetbook 486DX/33 (i486DX/33)								2.90
Micro Electronics WinBook (Cx486SLC/E/33)								2.41
Micro Express NP943 Notebook PC (i486DX/33)								2.38
Mitsuba Ninja 486SL/25 (i486SL/25)								1.99
NEC UltraLite Versa 25C (i486SL/25)								4.26
Packard Bell 486DX/25 Notebook (i486DX/25)								2.64
PC Brand Color LeaderBook Pro (i486DX/33)								3.90
Poly NB325V (i386SL/25)								1.49
Poly NB425C (Cx486SLC/25)								1.82
Samsung NoteMaster Model S3800 (Cx486SLC/25)								1.90
Santron 486 Jetbook (i486DX/33)								2.19
Tenex 486SLC/25 (i486SLC/25)								1.26
Tenex 486SL/33 Chroma (i486DX/33)								2.42
Ti WinSLC/25 (i486SL/25)								1.77
Ti 4000 WinDX/25 (i486DX/25)								3.02
Ti 4000 WinDX/25 Color (i486DX/25)								2.52
Ti 4000 WinDX/25 (i486DX/25)								3.15
Ti 4000 WinDX/25 (i486DX/25)								2.53
Ti 4000 WinDX/25 (i486DX/25)								2.48
Toshiba Satellite T1850C (i386SL/25)								1.82
Toshiba T4400C (i486DX/25)								3.54
Toshiba T4500 (i486SL/20)								2.84
Toshiba T4500C (i486SL/20)								2.81
Twinhead Slimnote 4DX/33T (i486DX/33)								1.77
Twinhead Slimnote 4SL/33M (i486SL/33)								3.44
Twinhead Slimnote 4DX/33T (i486DX/33)								2.69
ZDS Z Lite 320L (i386SL/20)								1.27
ZDS Z Note 425SLC Model 120 (i486SL/25)								3.38
ZDS Z Note 425SLC Model 200 (i486SL/25)								3.33
ZDS Z Note 425SLC Model 120 (i486SL/25)								3.34
ZDS Z Sport 425C (i487SL/20)								1.58
ZDS Z Sport 425C (i487SL/20)								1.70
Zeos Contenda (i386SL/25)								1.38

WORST

BEST

DISK WINMARK

Kilobytes per second	0	10	20	30	
AST PowerExec EL Color (386SL/25)					12.97
AST PowerExec 3 25SL Color (386SL/25)					20.52
AST PowerExec 4 25SL Color Plus (486SL/25)					26.74
Aurum GoldNote LX250 (486DX2/50)					25.47
Blue Star 486DX/66 (486DX2/66)					30.75
CAF Aqua ITE (486SL/25)					13.69
Compaq Contura 4 25 (486SL/25)					19.76
Compaq Contura 4 25L (486SL/25)					18.01
Compaq Contura 4 25CX (486SL/25)					20.33
Compaq LTE Lite 25L (486SL/25)					14.84
Compaq LTE Lite 4 25L (486SL/25)					21.90
CompuAdd Express 425Color (486SLC/25)					12.14
CompuAdd Express 425ColorPlus (486SLC/25)					20.97
CompuAdd Express 425SL (486SL/25)					16.52
Compudyne Color Slimnote (486DX2/66)					31.73
Compudyne Monochrome Slimnote (486DX2/66)					31.70
Compudyne 4S, 25 Subnote (486SL/25)					11.25
DeL NL25 (386SL/25)					12.72
DeL NL25L (386SL/25)					12.82
DeL 325N (386SL/25)					20.76
DeL 325NC (386SL/25)					20.96
DeL 325S (386SL/25)					20.38
Digital DECpc 425L (386SL/25)					12.34
Digital DECpc 425L (386SL/25)					12.70
Digital DECpc 425SL (486SL/25)					19.04
Epson ActionNote 4S, 25 (486SLC/25)					18.25
Epson PowerBook 486 (486SL/33)					23.84
Gateway Nomad 425SL (486SL/25)					22.00
Gateway Nomad 450DX (486DX2/50)					30.84
GR-D Convertible (386SL/25)					9.35
HyperBook 2300DL (40) (486DL/40)					27.94
HyperBook 2300DX (50) (486DX2/50)					30.63
Hyundai Courier A386SX (25)					11.35
Hyundai Courier Spectra (486SLC/25)					21.95
IBM ThinkPad 720C (486SL/25)					23.53
Jetta JetBook 486DX 33 (486DX/33)					28.69
Micro Electronics WinBook (486SLC/33)					21.76
Micro Express NP94 Notebook PC (486DX/33)					23.23
Minolta Ninja 486SX 25 (486SX/25)					21.20
NEC UltraLite versa 4S (486SL/25)					20.17
Packard Bell 486DX 25 Notebook (486DX/25)					22.03
PC Brand Notebook LeaderBook Pro (486DX/33)					23.60
Poly NB375 (386SL/25)					13.04
Poly NB425 (486SL/25)					17.04
Samsung NoteMaster Mode S3800 (486SLC/25)					18.19
Santrix 486 JetBook (486SL/33)					18.89
Tenex 486SLC 25 (486SL/25)					20.97
Tenex 486DX 33 Chroma (486DX/33)					35.15
Ti WinSLC 25 (486SLC/25)					15.89
Ti 4000 WinDX 25 (486DX/25)					22.48
Ti 4000 WinDX2 40 Color (486DX2/40)					30.13
Ti 4000 WinDX2 50 (486DX2/50)					31.55
Ti 4000 WinSX 25 (486SX/25)					21.84
Ti 4000 WinSX 25 Color (486SX/25)					21.96
Toshiba Satellite T1150 (386SL/25)					11.82
Toshiba T4400 (486SL/25)					26.55
Toshiba T4500 (486SL/20)					19.76
Toshiba T4500C (486SX/20)					18.81
Twinhead Slimnote 40X/33T (486DX/33)					28.00
Twinhead Slimnote 40X/66T (486DX2/66)					33.57
Twinhead Slimnote 45X/33M (486SL/33)					24.20
ZDS Z-Lite 320 (386SL/20)					11.58
ZDS Z-Note 425Ln Mode 120 (486SL/25)					21.22
ZDS Z-Note 425Ln Mode 200 (486SL/25)					27.44
ZDS Z-Note 425Ln Mode 120 (486SL/25)					20.82
ZDS Z-Sport 420 (487SX/20)					16.28
ZDS Z-Sport 425S (487SX/25)					21.28
Zeos Contenda (386SL/25)					13.49

WORST

BEST

WINDOWS APPLICATIONS

Seconds	0	500	1,000	1,500	
AST PowerExec EL Color (386SL/25)					1,572
AST PowerExec 3 25SL Color (386SL/25)					1,177
AST PowerExec 4 25SL Color Plus (486SL/25)					726
Aurum GoldNote DX2-50 (486DX2/50)					624
Blue Star 486DX2/66 (486DX2/66)					452
CAF Aqua ITE II (486SL/25)					1,342
Compaq Contura 4/25 (486SL/25)					738
Compaq Contura 4/25C (486SL/25)					775
Compaq Contura 4/25CX (486SL/25)					736
Compaq LTE Lite 25L (386SL/25)					1,241
Compaq LTE Lite 4/25C (486SL/25)					872
CompuAdd Express 425Color (486SLC/25)					1,084
CompuAdd Express 425ColorPlus (486SLC/25)					1,205
CompuAdd Express 425SL (486SLC/25)					1,216
Compudyne Color Slimnote (486DX2/66)					900
Compudyne Monochrome Slimnote (486DX2/66)					587
Compudyne 4S, 25 Subnote (486SL/25)					1,471
DeL NL25 (386SL/25)					1,294
DeL NL25C (386SL/25)					1,256
DeL 325N (386SL/25)					1,208
DeL 325NC (386SL/25)					1,219
DeL 325S (386SL/25)					1,206
Digital DECpc 325SL (386SL/25)					1,350
Digital DECpc 325SLC (386SL/25)					1,362
Digital DECpc 425SL (486SL/25)					782
Epson ActionNote 4S, 25 (486SLC/25)					1,262
Epson PowerBook 486 (486DX/33)					714
Gateway Nomad 425SL (486SL/25)					722
Gateway Nomad 450DX (486DX2/50)					537
GR-D Convertible (386SL/25)					1,130
HyperBook 2300DL (40) (486DL/40)					565
HyperBook 2300DX (50) (486DX2/50)					482
Hyundai Courier A386SX (25)					1,064
Hyundai Courier Spectra (486SLC/25)					1,468
IBM ThinkPad 720C (486SL/25)					701
Jetta JetBook 486DX 33 (486DX/33)					640
Micro Electronics WinBook (486SLC/33)					1,237
Micro Express NP94 Notebook PC (486DX/33)					721
Minolta Ninja 486SX 25 (486SX/25)					901
NEC UltraLite versa 25C (486SL/25)					784
Packard Bell 486DX 25 Notebook (486DX/25)					795
PC Brand Color LeaderBook Pro (486DX/33)					730
Poly NB375 (386SL/25)					1,329
Poly NB425 (486SL/25)					1,263
Samsung NoteMaster Mode S3800 (486SLC/25)					1,102
Santrix 486 JetBook (486SL/33)					1,015
Tenex 486SLC 25 (486SL/25)					1,167
Tenex 486DX 33 Chroma (486DX/33)					685
Ti WinSLC 25 (486SLC/25)					1,873
Ti 4000 WinDX/25 (486DX/25)					803
Ti 4000 WinDX2 40 Color (486DX2/40)					729
Ti 4000 WinDX2/50 (486DX2/50)					576
Ti 4000 WinSX 25 (486SX/25)					897
Ti 4000 WinSX 25 Color (486SX/25)					912
Toshiba Satellite F1850C (386SL/25)					1,900
Toshiba T4400C (486DX/25)					793
Toshiba T4500 (486SX/20)					895
Toshiba T4500C (486SX/20)					900
Twinhead Slimnote 40X/33T (486DX/33)					601
Twinhead Slimnote 40X/66T (486DX2/66)					442
Twinhead Slimnote 45X/33M (486SL/33)					682
ZDS Z-Lite 320 (386SL/20)					1,755
ZDS Z-Note 425Ln Mode 120 (486SL/25)					728
ZDS Z-Note 425Ln Mode 200 (486SL/25)					713
ZDS Z-Note 425Ln Mode 120 (486SL/25)					712
ZDS Z-Sport 420S (487SX/20)					946
ZDS Z-Sport 425S (487SX/25)					762
Zeos Contenda (386SL/25)					1,658

BEST

WORST

486: Hybrid Office") creates a new paradigm by combining a Cyrix SLC/25-based notebook computer with an ink jet printer in a 7.7-pound package.

We also encountered four subnotebooks, each weighing less than 4 pounds: the CompuDyne 4SL/25 Subnote, Dell 325SLi, ZDS Z-Lite 320L, and Zeos Contenda. In our opinion, none offers enough of the power and practicality of a full-featured product to compete. Adequate for simple tasks such as collecting electronic messages on the road, subnotebooks are likely to disappoint when it comes to writing a memo or going over a spreadsheet.

The most talked-about subnotebook started shipping after our deadline: The Hewlett-Packard OmniBook 300, a sub-\$2,000, instant-on system with several Windows applications in ROM and a permanently attached pull-out mouse; it can use an infrared connection to transfer files to desktop PCs and printers. The system can be thought of as a docking station for a variety of functional PCMCIA cards, including memory (hard disk or flash memory), applications, or network or modem card. HP took two big gambles with this PC: eliminating the screen's backlight to extend battery life, and using a 386-class CPU to contain costs.

At the other size extreme are suitcase computers that have multimedia pretensions (see the sidebar "Multimedia on the Go"). The recently announced Toshiba T6600C is the newest and most capable, with a built-in sound system and speakers, two ISA slots, and room for a 5.25-inch CD-ROM drive and a digital video interactive adapter. Weight: 17 pounds; cost: \$7,500 to \$9,500, depending on user-specified options.

SORTING IT OUT

With such an embarrassment of riches to choose from, we offer a few suggestions. Steer toward a 486-class color system. Get a large hard disk on the order of at least 120MB. Try several built-in pointing devices and select the one you like best. If high-speed communication is important to you right now, you may be safer with a notebook that has an internal modem slot. We have included in this roundup a compilation of those portable PC features we like and those we abhor.

Perhaps most importantly, look at our

Suitability to Task: Portable PCs

Road warrior rates how complete a traveling companion each system is. Excellent units combine small size, light weight, long battery life, large hard disk capacity, and good communications options.

DOS applications measures a system's ability to run DOS software quickly. Excellent systems have at least a 25-MHz 386 CPU, an 80MB hard disk, a 9-inch display, and a DOSmark score in the top 25 percent of the group.

Windows applications measures CPU speed and high-volume data storage. Top units have system RAM expandable to at least 8MB, an optional 120MB hard disk available, a built-in pointing device, and Microsoft Windows-compatible power management capabilities. In addition, the best units received Graphics Winmark, Disk Winmark, and Windows Applications test scores in the top 25 percent of the roundup.

An excellent **desktop replacement** offers suitable internal expansion or a docking station option, has

a hard disk of at least 120MB and a good keyboard, and supports an external SVGA monitor.

SERVICE AND RELIABILITY

In our 1993 Service and Reliability Survey, we sent questionnaires to 17,000 random subscribers; about half of them responded. We publish results only for those vendors for which we received an adequate number of responses. For more information, please see our July 1993 issue. Vendors are rated *above average*, *average*, or *below average* in three areas:

Product Name

SUITABILITY TO TASK	
Road warrior	POOR
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	EXCELLENT
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	BELOW AVERAGE

Reliability scores indicate to what degree PC owners felt the systems they purchased met their overall expectations for consistent operation.

Repair service scores are culled from those users who contacted the manufacturers to have their PCs repaired. The scores reflect users' satisfaction with the service they were given.

Technical support scores are a measure of how well the vendors' telephone support services met the respondents' expectations.

service and support ratings for the largest vendors. It is interesting to note that Compaq, Dell, IBM, Toshiba, and Zeos received scores significantly above the average on all three measures, and stand out as vendors of choice. A few vendors now cover repairs for three years, not just one. Others will replace a faulty system overnight.

In most cases, the 68 system reviews that follow are arranged alphabetically by vendor. In addition, three systems shipped too late for inclusion—a subnotebook from Twinhead Corp., a 486SLC-powered PS/Note from IBM, and a dual-scan passive color notebook from PC Brand. Multiple versions of essentially a single design are grouped together. Each review includes a Suitability to Task rating in four areas: road warrior, DOS applications, Windows applications, and desktop replacement.

A frequent traveler, for instance, may cherish extremely light weight and a great modem so much as to sacrifice computing power. More power-minded users might

value a high-quality screen so much that weight or battery life are immaterial to them. We all know there is no single ideal configuration for all the possible uses you can find for a laptop.

AST Research Inc.

AST PowerExec EL Color

AST PowerExec 3/25SL

AST PowerExec 4/25SL Color Plus

Digital Equipment Corp.

DECpc 325SL

DECpc 325SLC

DECpc 425SL

Competition in the laptop arena just keeps getting fiercer as evidenced by the deluge of new notebooks from AST Research. These machines are also sold by Digital Equipment Corp., which has

BING NEWS

**CompuAdd Rolls Out Its New Centura™ Series
And Rolls Over Competition.**

More Bays Than Compaq.

More Video Than Dell.

More Expansion Than IBM.

Introducing New CompuAdd

Bold New Designs! Maximum Upgradability!

C433D Low Profile



More Expansion!

4 bays, 5 slots. More than Dell, Compaq and IBM. Room for CD ROM, tape backup and floppy. Plus maximum internal expansion space.

- 33MHz 486DX Intel Processor
- Upgradable with Pentium™ Technology
- 4MB RAM, 128K Cache
- 212MB IDE Hard Drive
- 3.5" Floppy Drive
- Local Bus IDE Interface
- Local Bus ATI Video, 1MB RAM
- 14" Color Ultra VGA non-interlaced
- 5 16-Bit ISA Slots
- 4 Bays
- 2 Serial Ports,
- 1 Bi-directional Parallel Port
- 101 Key Keyboard
- Centura Low Profile Case
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, Netware Lite & Mouse

\$1,795

Lease for only \$65/mo.

C433D Desktop



Best Video!

Get CompuAdd's true color capability. 1MB VRAM provides faster video, faster refresh, and 16.7 million colors.

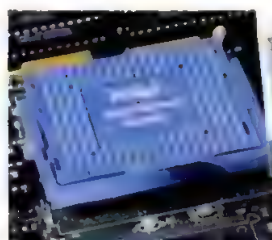
- 33MHz 486DX Intel Processor
- Upgradable with Pentium™ Technology (ZIF)
- 8MB RAM, 128K Cache
- 212MB IDE Hard Drive
- 3.5" Floppy Drive
- CD-ROM Drive
- Local Bus IDE Interface
- VLB ATI Graphics Ultra Pro, 1 MB VRAM
- 15" Flatscreen Color non-interlaced
- 8 16-Bit ISA Slots, 2 w/ 32-Bit VLB
- EISA Upgrade Available
- 7 Bays
- 101 Key Keyboard
- Centura Desktop Case (Mini-Tower option, Tower upgrade)
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, Netware Lite & Mouse

\$2,295

Lease for only \$83/mo.



CD ROM included in Towers, Mini-Towers, and Desktops. It's a Low Profile upgrade option.



Zero Insertion Force (ZIF) socket gives you easy upgradability to Intel Pentium technology.

Centura Series.

Risk Free Service Package!

C466D Mini-Tower



Faster Than Competition!

VESA local bus IDE provides faster data access. VESA local bus video scores up to 40 million on Winmark tests.

- 66MHz 486DX2 Intel Processor
- Upgradable with Pentium Technology (ZIF)
- 8MB RAM, 128K Cache
- 340MB IDE Hard Drive
- 3.5" Floppy Drive
- CD-ROM Drive
- Local Bus IDE Interface
- VLB ATI Graphics Ultra Pro, 1MB VRAM
- 15" Flatscreen Color non-interlaced
- 8 16-Bit ISA Slots, 2 w/32-Bit VLB
- EISA Upgrade Available
- 7 Bays
- 101 Key Keyboard
- Centura Mini-Tower Case (Desktop option, Tower upgrade)
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, Netware Lite & Mouse

\$2,695

Lease for only \$98/mo.

C466De Tower



Upgrade to Pentium Technology!

All Centura Towers have Zero Insertion Force (ZIF) sockets, which support Intel Pentium technology. Towers with 9 bays and 8 slots—perfect for power servers.

- 66MHz 486DX2 Intel Processor
- Upgradable with Pentium Technology (ZIF)
- 8MB RAM, 256K Cache
- 525MB SCSI Hard Drive
- 3.5" Floppy Drive
- CD-ROM Drive, Dual Speed, SCSI
- 32-Bit EISA FAST SCSI-2 & Local Bus IDE
- VLB Windows Accelerated Video w/1MB RAM
- 14" Color Ultra VGA non-interlaced
- 8 32-Bit EISA Slots, 2 w/32-Bit VLB
- 9 Bays
- 101 Key Keyboard
- Centura Tower Case (Desktop, Mini-Tower options)
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, Netware Lite & Mouse

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Lease for only \$121/mo.



Adjustable rear cover protects and organizes cables on Towers. Just slide the panel down to hide and protect the cables.



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Readers' Choice
for Service and
Reliability.**

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S E R I E S

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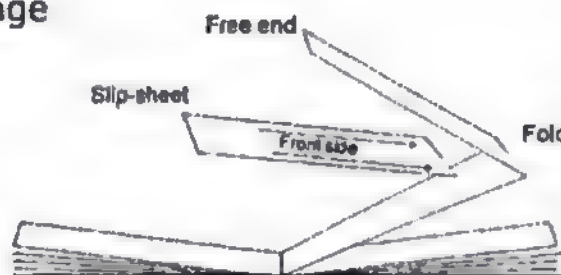
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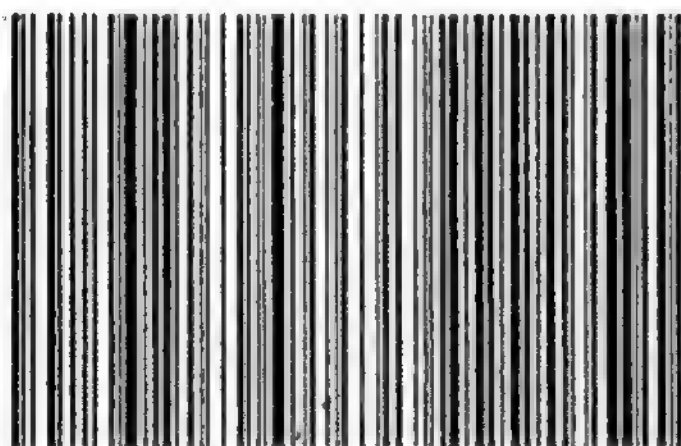


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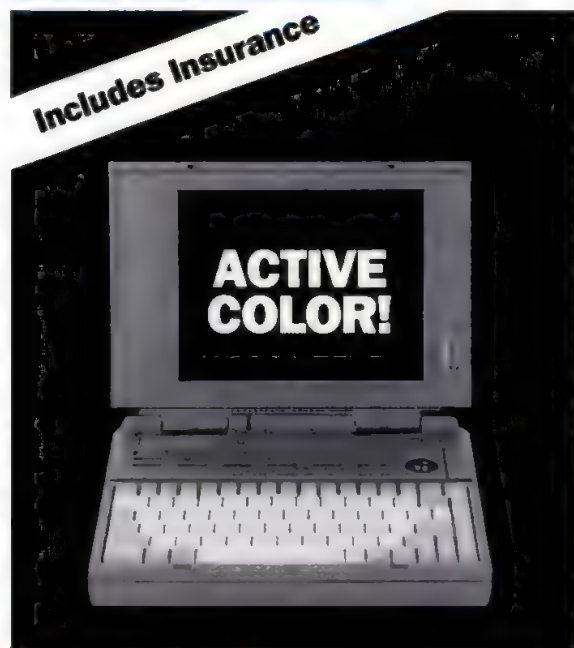
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Desktops and Notebooks.

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425TXT Color Notebook



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Intel 25MHz 486SX CPU. Built-in fax/modem. Bigger trackball and buttons make for easier use. 200MB IDE hard drive, 4MB RAM.

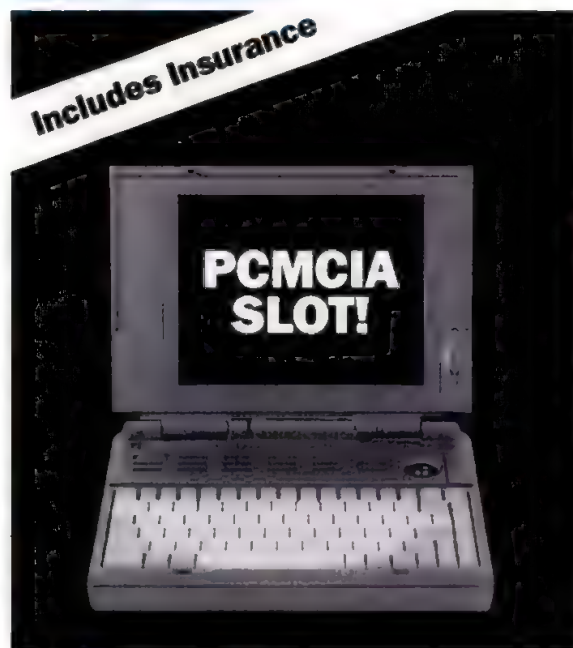
- Active Matrix LCD Display (640x480 resolution for 256 colors)
- 25MHz 486SX Intel Processor
- Display: 9.5" usable diagonally
- 6.1 pounds including battery
- 3.5" Internal Floppy
- PCMCIA Slot, Type II 2.0
- 2 to 4 hours of battery life*
- 9600 Baud Fax/2400 Baud Modem for send/receive capability. Free Fax/Modem Software
- 200MB IDE Hard Drive
- 4MB RAM, expandable to 8MB
- Built-in Mouse Trackball
- Serial, Parallel, Keyboard, and Printer Ports
- External VGA Video Port for simultaneous display
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, A/C Adapter and Carrying Case

\$3,695

Lease for only \$128/mo.

*Battery life depends on application, individual use and power management.

425TX Notebook



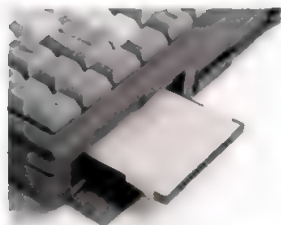
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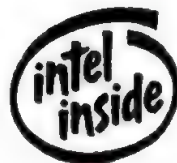
- 64 Grayscale Monochrome Display (edge lit, .30mm dot pitch)
- 25MHz 486SX Intel Processor
- Display: 9.5" usable diagonally
- 5.7 pounds including battery
- 3.5" Internal Floppy
- PCMCIA Slot, Type II 2.0
- 3 to 5 hours of battery life*
- 9600 Baud Fax/2400 Baud Modem; Free Fax/Modem Software
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- 4MB RAM, expandable to 8MB
- Built-in Mouse Trackball
- Serial, Parallel, Keyboard, and Printer Ports
- External VGA Video Port for simultaneous display
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- Local Bus IDE Interface
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- Local Bus ATI Video, 1MB RAM
- 14" Color Ultra VGA non-interlaced
- 5 16-Bit ISA Slots

- 2 Serial Ports
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- 101 Key Keyboard
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- Local Bus IDE Interface
- Local Bus ATI Video, 1MB RAM
- 14" Color Ultra VGA non-interlaced
- 5 16-Bit ISA Slots

- 2 Serial Ports
- 1 Bi-directional Parallel Port
- 101 Key Keyboard
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- 212MB IDE Hard Drive

- 3.5" Floppy Drive
- CD-ROM Drive
- Local Bus IDE Interface
- VLB ATI Graphics Ultra Pro, 1MB VRAM
- 15" Flat-screen Color non-interlaced
- 8 16-Bit ISA Slots, 2 w/32-Bit VLB

- EISA Upgrade Available
- 7 Bays
- 101 Key Keyboard
- Desktop option, Tower upgrade
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, Netware Lite & Mouse

\$2,295

Lease for only \$83/month

C466D Mini-Tower

- 66MHz 486DX2 Intel Processor
- Upgradable with Pentium Technology (ZIF)
- 8MB RAM, 128K Cache
- 340MB IDE Hard Drive

- 3.5" Floppy Drive
- CD-ROM Drive
- Local Bus IDE Interface
- VLB ATI Graphics Ultra Pro, 1MB VRAM
- 15" Flat-screen Color non-interlaced
- 8 16-Bit ISA Slots, 2 w/32-Bit VLB

- EISA Upgrade Available
- 7 Bays
- 101 Key Keyboard
- Desktop option, Tower upgrade
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Lease for only \$98/month

C466D Mini-Tower

- 66MHz 486DX2 Intel Processor
- Upgradable with Pentium Technology (ZIF)
- 16MB RAM, 256K Cache
- 340MB IDE Hard Drive

- 3.5" Floppy Drive
- CD-ROM Drive
- Local Bus IDE Interface
- VLB ATI Graphics Ultra Pro, 1MB VRAM
- 15" Flat-screen Color non-interlaced
- 8 16-Bit ISA Slots, 2 w/32-Bit VLB

- EISA Upgrade Available
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- 3.5" Floppy Drive
- CD-ROM Drive, Dual Speed, SCSI
- 32-Bit EISA FAST SCSI-2 & Local Bus IDE
- VLB ATI Graphics Ultra Pro, 1MB VRAM
- 15" Flat-screen Color non-interlaced

- 8 32-Bit EISA Slots, 2 w/32-Bit VLB
- 7 Bays
- 101 Key Keyboard
- Desktop option, Tower upgrade
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C466De Tower

- 66MHz 486DX2 Intel Processor
- Upgradable with Pentium Technology (ZIF)
- 8MB RAM, 256K Cache
- 525MB SCSI Hard Drive

- 3.5" Floppy Drive
- CD-ROM Drive, Dual Speed, SCSI
- 32-Bit EISA FAST SCSI-2 & Local Bus IDE
- VLB Windows Accelerated Video w/1MB RAM
- 14" Color Ultra VGA non-interlaced

- 8 32-Bit EISA Slots, 2 w/32-Bit VLB
- 101 Key Keyboard
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- 25MHz 486SX Intel Processor
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- 9600 Baud Fax/2400 Baud Modem, Free Fax/Modem Software

- IDE Hard Drive
- 4MB RAM, expandable to 8MB
- Built-in Mouse Trackball
- Serial, Parallel, Keyboard, and Printer Ports
- External VGA Video Port for simultaneous display
- Free MS DOS 6.0, Windows 3.1, Close-Up 4.0, A/C Adapter and Carrying Case

425TX Notebook

- 64 Grayscale Monochrome Display (edge lit, 30mm dot pitch)
- 120MB IDE Hard Drive
- 3 to 5 hrs. of battery life*

\$1,895

Lease for only \$69/mo.

425TXT Notebook

- Active Matrix LCD Display (640x480 resolution for 256 colors)
- 200MB IDE Hard Drive
- 2 to 4 hrs. of battery life*

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AST PowerExec EL Color	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

in some cases tweaked them a little. Though the 386 members of this family exhibited generally average performance coupled with monochrome or below-average passive-matrix color screens, all had competitive pricing and feature sets.

By contrast, the AST PowerExec 4/25SL

Color Plus with its brilliant active-matrix color screen, managed to stand out as an excellent buy in today's notebook market. You don't have to go to AST's high end to obtain TFT color, however. All of the PowerExecs are fully user-upgradable in terms of their processors, memory, hard disks, and screens.

AST COLOR PLUS AND DECpc 425SL

Powered by Intel's 3.3-volt 486SL 25-MHz silicon, the \$4,499 AST Color Plus stands out with a 9.5-inch TFT screen capable of 256 colors at 640-by-480 resolution. The \$2,499 DECpc 425SL model offers the same processing power, but with a monochrome screen.

Both machines are capable of supporting up to a 200MB hard disk, flash BIOS, and two PCMCIA Type II slots. Though both systems have the same case size, the AST Color Plus's active-matrix screen bulks the unit's weight up to exactly 7 pounds, while the DEC remains at only 6.3 pounds. Both machines can hold up to 32MB of system memory. The DEC system comes standard with a front-mounted trackball, although this is an option on the Color Plus. You can get a \$99 drive bay adapter from AST for shuttling data between the Color Plus's hard disk and that of a desktop.

FACT FILE

AST PowerExec EL Color

AST PowerExec 3/25SL Color

AST PowerExec 4/25SL Color Plus

AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92619-7005; 800-876-4278, 714-727-4141; fax, 714-727-9355

List price: EL Color, \$2,799; 3/25SL Color, \$3,499. 4/25SL Color Plus, \$4,499

Tested configuration: 4MB 70-ns RAM (3/25SL Color came with 64KB of external cache), 120MB Toshiba MK2124FC IDE hard disk with 32K cache (EL), 160MB Quantum GRS160AT IDE hard disk with 32K cache (3/25SL), 200MB Seagate ST9235AG IDE hard disk with 64K buffer (4/25SL); 1.44MB floppy disk drive; DOS 5.0, Microsoft Windows 3.1; SmartPoint trackball



The AST PowerExec EL Color, PowerExec 3/25SL Color, and PowerExec 4/25SL Color Plus

Options: SmartPoint trackball, \$69; PowerStation docking station, \$449, EasyPort, \$139, extra nickel cadmium battery, \$119; 14,400-/9,600-bps PCMCIA data/fax modem, \$599, PCMCIA Ethernet LAN adapter models 10BT and 10B2, \$329 and \$349, respectively

In short: With this iteration, AST has hit the big time in the notebook computer market with its PowerExec line. These powerful and light-weight systems have all the options you're looking for: active-matrix color, PCMCIA, internal clip-on pointing device, advanced power management, and upgradable hard disks and processors

 ON READER SERVICE CARD

Performance was adequate for both machines on our benchmark tests, with the AST unit edging out the DEC offering on everything but the video test suite. Here the combination of monochrome LCD and a 486-level processor pushed the DEC into first place overall. The DECpc 425SL really shone in terms of

battery life. The DEC unit came in at a whopping 4 hours 3 minutes on the Battery Rundown test (many systems couldn't manage that on the ZDigit Rundown test!) and an incredible 9 hours 34 minutes on the ZDigit test with power-management features enabled. The AST Color Plus was no slouch, however, with a respectable 2 hours 14 minutes on the Battery Rundown test and 6 hours 17 minutes with all power-saving features enabled. In an emergency you can run both machines with 12 AA batteries.

ALL THE OTHERS

The rest of the machines in this portable PC group are largely identical. All based around 386-class processors and featuring design options similar to their 486 counterparts, the \$3,499 AST PowerExec 3/25SL Color, \$2,799 AST PowerExec EL Color, and \$2,899 DECpc 325SLC also sport disappointing passive-matrix color screens—only the \$2,099 DECpc 325SL remains a monochrome system.

These machines displayed color that was disappointing compared not only with active-matrix color but with the color of a number of other passive-matrix machines as well. The AST EL Color and the DECpc 325SLC exhibited the worst characteristics: excessive bands of gray along almost an inch of border, obvious ghosting, and uneven lighting during Windows' BitBltting

AST PowerExec 3/25SL Color	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

AST PowerExec 4/25SL Color Plus	
SUITABILITY TO TASK	
Road warrior	EXCELLENT
DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Price/Performance Index: Portable PCs

The era of the high-performance notebook has arrived. Of the 68 notebook systems we reviewed for this roundup, 28 had color displays and 51, an overwhelming majority, used a 486-class CPU from Advanced Micro Devices, Cyrix, Intel, or IBM. With the current generation of notebooks, you give up relatively little in terms of computing

power when you take your desktop applications on the road.

Color units still carry higher price tags, but two passive-matrix display systems managed to land in the best price/performance sector. These color-on-the-cheap systems were the Ergo PowerBrick 486 and the AST PowerExec EL Color.

Digital Equipment Corp.'s DECpc 325SL and 425SL had the best price/performance scores, thanks to a robust mix of features and excellent Battery Rundown test results. Among the next ones were the Gateway Nomad 425SXL and Nomad 450DXL, as well as the nearly identical TI TravelMate 4000 WinSX/25 and WinDX2/50. Also in the



FACT FILE

DECpc 325SL

DECpc 325SLC

DECpc 425SL

Digital Equipment Corp., 50 Nagog Park,
Acton, MA 01720; 800-722-9332;
fax, 800-524-5624

List price: 325SL, \$2,099; 325SLC, \$2,899; 425SL, \$2,499.

Tested configuration: 4MB 80-ns RAM with 64K of



The DECpc 325SL, DECpc 325SLC, and DECpc 425SL

external cache (325SL, 325SLC), 4MB 70-ns RAM with 8K of external cache (425SL); 84MB Toshiba MK-2024FC IDE hard disk with 32K buffer (325SL, 325SLC), 120MB Seagate IDE hard disk with 512K buffer (425SL); 1.44MB floppy disk drive; DOS 5.0; Microsoft Windows 3.1; snap-on trackball.

Options: 200MB hard disk upgrade, \$400; 8MB RAM upgrade, \$900; 12MB RAM upgrade, \$1,800; docking station, \$379; port replicator, \$89; extra nickel hydride battery, \$169; external 2,400-/9,600-bps data/fax modem, \$300; Xircom Ethernet adapter, \$405; math coprocessor, \$229; external keyboard, \$79; numeric keypad, \$79; battery charger, \$49; extra AC adapter, \$79.

In short: The DECpcs offer almost all the winning options contained in the PowerExec line and at times offer several tweaks. In this roundup, DEC exhibited only passive-matrix color and it's of the same dismal quality as AST's. On the other hand, DEC's battery scores were outstanding.



operations. The AST 3/25SL Color's screen seemed slightly better but was still uncompetitive.

Performance was competitive for 386-class products in a market moving largely toward the 486. The two DECpc 386-based units and the AST 3/25SL Color performed closely on almost all tests: pro-

cessor and memory scores were average and video was exceptionally fast, while disk scores under both DOS and Windows fell below par. The AST EL Color, on the other hand, fell significantly behind its siblings and stayed there on every test, placing near last of all tested units in some tests.

Battery rundown times were surpris-

DECpc 325SL

SUITABILITY TO TASK

Road warrior	EXCELLENT
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR

ing for the most part, especially for the DEC products. Even though some of the niftier power-management features of the AST units are not to be found on the DEC's, the DECpc 325SLC still managed to last 2 hours 20 minutes on the regular bat-

tery test and 5 hours 2 minutes on the ZDigit test. The monochrome DECpc 325SLC blew the DECpc 325SLC away, lasting 3 hours 41 minutes with power-management features disabled and a wondrous 8 hours 33 minutes on the ZDigit test. The more colorful ASTs, on the other hand, couldn't keep up, with the AST 3/25SL Color coming in at 1 hour 35 minutes on the Battery Run-down test and 4 hours 48 minutes in power-management mode. As usual, the AST EL Color lagged slightly behind its sibling, staying alive for 1 hour 30 minutes on the straight rundown test and 4 hours 3 minutes on the ZDigit test. —Oliver Rist

DECpc 325SLC

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR

DECpc 425SL

SUITABILITY TO TASK

Road warrior	EXCELLENT
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR

price/performance sweet spot was the Jetta Jetbook 486DX/33.

At \$3,249 and about average on our performance scale was the Compaq Contura 4/25C, which is our value leader. Its dual-scan passive-matrix color screen leads other color units in its price range in image quality, and it has both the performance and battery life of systems that cost hundreds more. Among the active-matrix color displays, the top performers were the AST PowerExec 4/25SL Color Plus, the Twinhead Slimnote 4DX2/66T, the IBM ThinkPad 720C, and the ZDS Note 425Lnc Model 200.

The systems that had trouble keeping up with the pack fall into the lower-left-hand corner of the chart, most notably the GRiD Convertible. Low-priced machines with relatively poor scores for performance and features include individual units from Hyundai, Polywell, and Tenex.

THE DATA POINTS

In determining performance scores, we consider benchmark test results (42 percent), RAM and hard disk capacities (8.5 percent), size and weight (22 percent), ZDigit Rundown time (11 percent), and features (16.5 percent).

The features category gives credit for larger display size, external VGA support, built-in pointing devices, PCMCIA slots, internal modems, user-installable nonproprietary RAM and expansion units, high-speed serial and parallel ports, port replicators, external keyboards, power-management features (including advanced power management support), battery hot swap, and separate cursor and PgDn, PgUp, Home, and End keys. The composite performance score is plotted on the x-axis versus the selling price of the tested configuration on the y-axis.

You can find more data in PC Mag-Net's Software Library Editorial Forum as 14BANG.WK1.

Aurum Computer Corp. Aurum GoldNote DX2-50

Aurum Computer Corp.'s \$2,395 Aurum GoldNote DX2-50 is a powerful portable with a removable hard disk. Unfortunately, it has very few power-conservation features and a short battery life. Its benchmark test scores spanned the range from below average to excellent.

The GoldNote's LCD panel displays up to 32 shades of gray at VGA resolution. It is extremely dark, with difficult-to-use control wheels. The GoldNote can display to the screen or an external monitor, but not simultaneously.

The cursor keys are arranged in an inverted-T layout but are difficult to use because they are half-size vertically. With



FACT FILE

Aurum GoldNote DX2-50

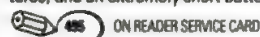
Aurum Computer Corp., 5 Pond Park Rd.,
Hingham, MA 02043; 800-552-8786,
617-749-5092; fax, 617-749-5188

List price: \$2,395.

Tested configuration: 4MB 70-ns RAM, 127MB Quantum GO 120AT IDE hard disk with 32K buffer, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1., mouse.

Options: 210MB hard disk upgrade, \$150; 12MB RAM upgrade, \$900; hard disk docking bay, \$195; docking station, \$395; extra nickel cadmium battery, \$95; 2,400-/9,600-bps data/fax modem, \$113; Pocket LAN Ethernet adapter, \$325; external 1.2MB floppy disk drive, \$265; external keyboard, \$35; numeric keypad, \$99; hand scanner, \$205; portable printer, \$360.

In short: The Aurum GoldNote DX2-50, while delivering fairly solid performance, is hampered by a dark LCD panel, almost nonexistent power-conservation features, and an extremely short battery life.



Aurum GoldNote DX2-50

SUITABILITY TO TASK

Road warrior **FAIR**

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

enabled its power-conservation features (limited to user-adjustable display and hard disk power-downs).

Its test performance was mixed: Processor, memory, Disk Winmark, and Windows Applications scores were in the top quarter of the roundup, disk and Graphics Winmark scores were average, and a DOS video score was in the cellar.

The company will replace or repair a faulty unit within 48 hours—a great help while you're on the road. If you need processor power more than battery power, the GoldNote may be a welcome traveling companion.—Robin B. Bornstein

Blue Star Marketing Inc.

Blue Star 486DX2/66

The theory that a great notebook starts with a great chip is the philosophical basis for the Blue Star 486DX2/66 notebook. Unfortunately, the \$3,495 portable PC could have used this high flying CPU to better advantage. It was surpassed in both the CPU and memory benchmark tests by better-designed systems with the less capable DX2/50 processor, though it regained the lead in the Windows Application suite.

The system we tested had 8MB of system memory (upgradable to as much as 16MB) and a 210MB hard disk.

A major drawback to this machine is the 9.5-inch diagonal monochrome display. Though it is sizable and good for a passive matrix, it is as hard to view from an angle as any passive ma-

the Fn key, they perform double duty as Home, End, PgUp, and PgDn.

The GoldNote lasted only 1 hour 34 minutes without power conservation and only 17 more minutes when we



FACT FILE

Blue Star 486DX2/66

Blue Star Marketing Inc., 2312 Cantral Ave.
N.E., Minneapolis, MN; 800-950-8884,
612-788-5000; fax, 612-788-3442

List price: \$3,495.

Tested configuration: 8MB 70-ns RAM with 8KB of external cache, 210MB Toshiba 2224 IDE hard disk with 128K cache, 1.44MB floppy disk drive, 9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, built-in trackball.

Options: Docking station, \$599; extra nickel cadmium battery, \$99; 2,400-/9,600-bps data/fax modem, \$189; 12-volt adapter, \$99; Motorola cellular phone adapter, \$295.

In short: If you are in need of a power portable, the Blue Star's 486DX2/66 processor is certainly a good start. The system, however, turned in only mixed benchmark test performance, despite its high-powered processor, and its trackball was inconveniently positioned on the front of the unit.



trix and has overly sensitive contrast and brightness knobs. Another problem is the trackball that is inconveniently located on the front vertical side of the machine and is rather uncomfortable to use.

On the positive side, the Blue Star's keyboard is comfortable and well laid out. It has 85 keys, 12 somewhat small function keys, and 4 cursor keys.

Encased in no-scratch plastic, the Blue Star notebook is solidly built and has a travel weight of 8.3 pounds. On the battery tests, the Blue Star was able to operate for 1 hour 55 minutes on the Battery Rundown test and for 2 hours 48 minutes on the ZDigit Rundown test. Blue Star is working with Motorola and US West Cellular on a mobile office workstation that would include a cellular connection and an internal fax modem.

—Michael Bonomo

Blue Star 486DX2/66

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **EXCELLENT**

Windows applications **GOOD**

Desktop replacement **EXCELLENT**

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Xircom

CIRCLE 211 ON READER SERVICE CARD

CAF Technology Inc. CAF AquaLITE II

One of two portables in this roundup using the AMD Am386SXL/25 processor, the CAF AquaLITE II is a reasonably priced notebook stressing the basics of computing on the road. The list price is \$1,777 for a 4MB system with an 80MB hard disk. Our tested configuration—with a 120MB hard disk and 8MB of RAM—is \$2,399.

The AquaLITE II is based on a traditional notebook design; it weighs 5.5 pounds, and its case is solidly built. The keyboard does not seem so solid: Each key is flimsy to the touch, handling as if balanced on the tip of a pin. The keyboard also does not allow access to



FACT FILE

CAF AquaLITE II

CAF Technology Inc., 1315 Johnson Drive,
City of Industry, CA 91745; 336-9369,
818-369-3690; fax, 800-329-2537

List price: \$2,399.

Tested configuration: 8MB 70-ns RAM, 123MB Toshiba Mk-2124 IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem.

Options: 2MB upgrade, \$234; 4MB upgrade, \$403; mouse, \$20; extra battery, \$79; 2,400-/9,600-bps data/fax modem, \$188; numeric keypad, \$66; 12-volt battery adapter with converter, \$131; DOS 5.0, \$50; Microsoft Windows 3.1, \$65.

In short: Basic, and priced that way, the CAF AquaLITE II performs adequately, but its keyboard is a bit disappointing, and the unit lacks an integrated pointing device. On the plus side, the portable's monochrome VGA display was bright and offered crisp images, and battery life was adequate.

ON READER SERVICE CARD

CAF AquaLITE II

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

program. The system also lacks the built-in pointing device that is now almost standard for units in its class.

Although the AquaLITE II's rated battery life is only 2 hours, our ZDigit Rundown test with power conservation produced a respectable 3-hour time. The unit's other test results were generally comparable with those of most 386SL/25 units we tested.

The CAF AquaLITE II uses a Sharp monochrome VGA display which gives a very crisp image. While the unit covers most of the basics, there's scant reason to choose it aside from its price.

—Stephen W. Plain

Compaq Computer Corp.

Compaq LTE Lite 25E

Based on a 25-MHz 386 processor, the \$3,249 Lite LTE Lite 25E is something of an experiment, seeing whether buyers will pay for a monochrome active-matrix display.

Aside from screen technology, the Lite 25E has the same features as the rest of the Lite line from Compaq Computer Corp.: flash-upgradable BIOS, upgradable processor and hard disk, an extra battery, fast and trickle charging, and, of course, the screen-mounted trackball. As with other Lite line products, its keyboard's stiff resistance

system options through the existing Fn key, as most other units do. Power management and system configuration can be accessed only through an external setup program.



FACT FILE

Compaq LTE Lite 25E

Compaq Computer Corp., P.O. Box 692000,
Houston, TX 77269-2000; 800-345-1518,
713-370-0670

List price: \$3,249 (estimated selling price).

Tested configuration: 4MB 70-ns RAM with 64K external cache, 84MB Conner Henshu IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 14,400-/9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1., Compaq EasyPoint.

Options: Compaq mouse, \$39; 14,400-/9,600-bps data/fax modem, \$399; enhanced keyboard, \$89; numeric keypad, \$79; battery charger, \$89; extra AC adapter, \$129; 12-volt battery adapter, \$89; SCSI-2 controller, \$139; Compaq 1024, QVision and SVGA monitors, \$2,499; briefcase, \$119; carrying case, \$59.

In short: Basically, a high-end portable targeted at a niche market, the LTE 25E is meant for those who want a 386-based portable as their primary machine and desire an active-matrix monochrome display.

ON READER SERVICE CARD

and slightly short key travel may not meet with some users' approval.

Performance was respectable for a 386-class product. The Lite 25E's 25-MHz 386 processor was on the low end of this roundup's processor spectrum and scored generally in the lower quarter of all machines reviewed. In its own CPU group, however, it placed first on the processor test and fourth or fifth on all the other hardware benchmark tests. Its Windows performance was sixth among its CPU peers and fifty-third among all machines reviewed. The Lite 25E managed 2 hours 57 minutes on PC Labs' Battery Rundown test and 3 hours 32 minutes on the ZDigit Rundown test with power-saving features enabled.

Compaq ships this machine with a three-year parts-and-labor warranty that also includes on-site service.—Oliver Rist

Compaq LTE Lite 25E

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **GOOD**

Desktop replacement **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE
AVERAGE**

Repair service **ABOVE
AVERAGE**

Technical support **ABOVE
AVERAGE**

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CIRCLE 079 ON READER SERVICE CARD

Power to the Portables

by Robert S. Anthony

How do you spell *headache*? Ask a portable computer user and the answer might be b-a-t-t-e-r-y. You've probably seen what a persistent beep or flashing "Low Batt" signal can do to a laptop user's stress level when the notebook indicates that its battery is about to expire.

Whether based on alkaline, sealed lead-acid, nickel cadmium, or nickel hydride, a rechargeable battery is designed, ideally, to produce the maximum amount of power from the smallest, lightest cell. A combination of new technologies, better power management, and proposed size standards may soon allow you to put more time and distance between yourself and an AC wall outlet.

While portable computers have inched closer to being full desktop replacements in terms of raw computing ability, some people still swear by their ancient Tandy Radio Shack Model 100 portables—the industry's first true notebooks. Why? Even though its computing power is almost comical by today's standards (it didn't even have a built-in floppy or hard disk drive), the Model 100 provided, above all, a long and reliable battery life in a light and convenient package.

Of course, today's portables make heavier demands on their batteries than the Model 100s because modems, disk drives, hard disks, color displays, and other hardware features take their toll on battery life. The response by computer-battery and laptop makers has been twofold: Today's batteries are both more powerful and more efficient.

Although the nickel cadmium battery—the current laptop power source

of choice—may lose some ground to newer technologies, it will not be made obsolete for some time, according to Don West, president of the House of Batteries, a retail/wholesale battery store in Huntington Beach, California (800-432-3385). The reason is that

operation and a system-management mode that, with good power-management software, can drastically increase battery life.

Nickel hydride batteries are a good choice for the immediate future since they aren't susceptible to the memory

Tomorrow's Batteries: Packing More Punch

	Cost (per watt-hour)	Power density (watt-hours per kilogram)	Lifetime (recharge cycles)
Nickel cadmium	\$0.70–\$1.40	33–45	500–1,000
Nickel hydride	\$1.50	50–56	500–1,000
Lithium ion	\$1.50	78–115	500–1,200
Lithium polymer	\$0.75	205	175–300

Source: House of Batteries

nickel cadmium batteries have a proven track record and are relatively inexpensive.

Unfortunately, they can develop a problem if they're not allowed to fully discharge regularly. This problem, commonly called a *memory effect* (though engineers refer to it as *hysteresis*), can

be caused by charging a battery too frequently before it is fully discharged. This results in a cell that provides far less than its rated battery life.

Those of us who thought we were wise to keep these batteries in their chargers discovered, in hindsight,

that our foresight was shortsighted.

A CHIP SOLUTION

The development of low-power microprocessor lines such as Intel Corp.'s 386SL and 486SL and Advanced Micro Devices' Am386SXLV and Am486DXLV has aided the longevity of nickel cadmium battery technology. Both chip families combine 3.3-volt

effect, have higher power densities than nickel cadmium units, and are compatible with many battery chargers now in use. The result is that you can expect about 30 percent more power from them for the same weight, or, if you don't need the extra power, you can downsize the battery cell to reduce system weight. These positives about nickel hydride batteries and the fact that they don't contain environmentally dangerous cadmium are balanced by their higher price—often double that of comparable nickel cadmium units.

Sealed lead-acid batteries are more popular for starting cars and for uninterruptible power supply units than for portable PCs. They have long shelf lives and don't develop memory problems, but generally have lower power density than nickel cadmium or nickel hydride batteries. Recent packaging advances allow users to recharge them by plugging them directly into a wall socket—no charger is needed. IBM, for one, will be using sealed lead-acid batteries as an option for its new ThinkPad 500 sub-notebook, although whether this technology will become a popular alternative is uncertain.

Future battery types that would be

*New technologies
may allow you to
put more time and
distance between yourself
and an AC outlet.*

similar in size but more powerful than those mentioned above include cells of lithium ion and ultra-thin lithium polymer, which have the potential to lighten the next generation of laptops (see chart). They would come in flexible packages about 1/8-inch thick—more like moldable clay than the hard plastic battery packs to which we are so accustomed. Not only would these batteries have high power densities, but they could be wrapped around the inside of a laptop's case, taking good advantage of a notebook's small nooks and crannies.

HARD CELL

If you've ever shopped for a laptop battery, you know that buying one isn't as simple as AA, B, and C. Many laptop battery units are unique packages of small cells connected with wire or metal brackets. Finding the right laptop battery usually means contacting your laptop vendor or manufacturer; since battery shape is proprietary and varies greatly by manufacturer, the wrong battery will neither work nor fit the machine.

Duracell is hoping to simplify this situation by creating several standard sizes around which laptop makers would build their computers. Specifications for the battery sizes would be made available to other battery makers, according to Robert O'Keefe, strategic marketing manager for Duracell. "A standard really isn't a standard if it's proprietary," he said.

Duracell's goal is to standardize on five to ten battery sizes that would be interchangeable not only among portable computers, but also among other portable electronic devices, such as cellular telephones and portable CD players. The travel-bag-lightening effect of standardized computer battery types is obvious.

The Duracell standards were to be released later this year. However, you are likely to wait a long time for standardized battery types and the ability to buy a generic laptop power cell. □

Compaq Computer Corp.

Compaq LTE Lite 4/25C

The \$4,099 Compaq LTE Lite 4/25C is for those interested in using a notebook as a desktop replacement. That's why the Lite series, not the \$700-cheaper Compaq Contura 4/25CX, can connect to the \$579 Desktop Expansion Base from Compaq Computer Corp. or its Quick-Connect port replicator.

The Lite 4/25C uses a 25-MHz 486SL CPU and TFT color screen and includes flash-upgradable BIOS, fast battery charging (about an hour), trickle charging to prevent battery overload, and a screen-mounted trackball. Superior battery and power-conservation features include a standby button, three



FACT FILE

Compaq LTE Lite 4/25C

Compaq Computer Corp., P.O. Box 692000,
Houston, TX 77269-2000; 800-345-1518,
713-370-0670

List price: \$4,099.

Tested configuration: 4MB 70-ns RAM, Conner Henshu 16-ms 120MB hard disk with 32K buffer, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, built-in trackball.

Options: Compaq mouse, \$39; 14,400-bps cellular data/fax modem, \$849; 9,600-bps data/fax modem, \$399; enhanced keyboard, \$89; numeric keypad, \$79; battery charger, \$89; extra AC adapter, \$129; 12-volt battery adapter, \$89; SCSI-2 Controller, \$139; Compaq 1024, QVision, and SVGA monitors, \$2,499; briefcase, \$119; carrying case, \$59.

In short: The Lite LTE 4/25C is cheaper than many other active-matrix color offerings, yet it supports just about every feature you could want. The lack of a PCMCIA slot and a stiff keyboard were the only downsides.



ON READER SERVICE CARD

Compaq LTE Lite 4/25C

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

preset levels of conservation, and one user-configurable conservation level.

The Lite 4/25C casts only one shadow, extending to both LTE systems. The keyboard is stiff and doesn't have enough travel or response to satisfy everyone. Still, Compaq does not place either the Home, PgUp, PgDn, or

End key to the right of the Backspace key as others (including Toshiba America Information Systems) do, always causing chaos for those not used to such key placement.

The Lite 4/25C managed average or above-average scores compared with the whole roundup. With 486-class products, though, it encountered stiff competition: mainly the DX2/40, DX2/50, and DX2/66-MHz 486s now becoming popular. The 4/25C placed below-average on everything except disk scores, where it managed fifth place under DOS and third place under Windows. On PC Labs' Battery Rundown test, the Lite 4/25C scored 1 hour 52 minutes. On the ZDigit Rundown test, the Lite 4/25C scored a surprising 4 hours 12 minutes.

Compaq ships this product with a three-year parts-and-labor warranty including on-site service.—*Oliver Rist*

Compaq Computer Corp.

Compaq Contura 4/25

Compaq Contura 4/25C

Compaq Contura 4/25CX

In our last peek at notebooks (*PC Magazine*, March 30, 1993), the Contura value line from Compaq Computer Corp. managed a solid though not outstanding impression. That initial showing was improved on so much this time that the high-end LTE Lite line may be in jeopardy.

CONTURA 4/25CX

The Compaq Contura 4/25CX tries to be all things to all people. At a basic configuration price just below \$3,400, it will be almost \$700 less than the Compaq LTE Lite 4/25C.

Unfortunately for the Lite 4/25C, there is little difference between the two machines' feature sets. Both feature active-matrix color, the well-known screen-mounted internal trackball, similar-sized hard disks, and the same power management features. They're almost the same size and weight, too. The Lite 4/25C's only advantages are slightly faster hard disk performance, the ability to attach to a desktop expansion unit, and battery life of about an hour longer (with power-saving features enabled).

The rest of the Contura mirrors its siblings. The same solid, charcoal-gray case surrounds the 6.9-pound unit, and there is the same excellent, "clicky" keyboard. Its screen-mounted trackball is a departure from other Conturas that use a clip-on Trackman clone, but you can still attach the latter device if the internal one is not to your liking. Though documentation is excellent, the Lite line does have one more advantage over the Contura: You don't have to remove the keyboard to upgrade memory.

CONTURA 4/25C AND 4/25
The other two units are processor-upgraded versions of older



Compaq Contura 4/25, Compaq Contura 4/25C, Compaq Contura 4/25CX

FACT FILE

Compaq Contura 4/25

Compaq Contura 4/25C

Compaq Contura 4/25CX

Compaq Computer Corp.,

P.O. Box 692000, Houston, TX 77269-2000;
800-345-1518, 713-370-0670

List price: 4/25, \$2,499; 4/25C, \$3,249; 4/25CX, \$3,899 (estimated selling prices).

Tested configuration: 4MB 80-ns RAM, 120MB Conner Model CP2121 IDE hard disk with 32K cache, 1.44MB floppy disk drive, 9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, mouse.

Options: 4MB RAM upgrade, \$259; 8MB RAM upgrade, \$519; 16MB RAM upgrade, \$1,519; Compaq mouse, \$39; Compaq trackball, \$89; extra battery, \$29; 14,400-bps cellular data/fax modem, \$649; 9,600-bps data/fax modem, \$399; numeric keypad, \$79; battery charger/discharger, \$89; extra AC adapter, \$89; 12-volt adapter, \$109; external slipcase, \$19; carrying case, \$59; briefcase, \$119.

In short: This generation of Conturas from Compaq Computer Corp. have lifted themselves out of the value-line category by offering just about every high-tech feature you could possibly desire. All of these features come at a great price, too. All that's really missing from this line of portable machines is desktop expandability and PCMCIA slots.



Contura products. The Compaq Contura 4/25C and the Compaq Contura 4/25 sell for \$3,249 and 2,499, respectively, and mirror the 4/25CX in all respects save for the active-matrix screen with its internal trackball. The 4/25C boasts high-quality dual-scan passive-matrix color, while the 4/25 has monochrome.

Performance on PC Labs' benchmark

tests were largely identical for all three Conturas, except, of course, those on video. Processor and disk scores were average, while memory numbers were noticeably fast.

On PC Labs' battery tests, however, numbers varied

widely. Both the 4/25CX and the 4/25C had low Battery Rundown test scores (1 hour 36 minutes and 1 hour 47 minutes, respectively) but managed semi-competitive ZDigit Rundown test scores of 3 hours 1 minute and 3 hours 32 minutes, respectively. The monochrome 4/25 came in at 2 hours 28 minutes on the Battery Rundown test but only 3 hours 42 minutes on the ZDigit Rundown test. By contrast, both active-matrix LTE Lite units lasted over 4 hours on the ZDigit Rundown test.

Compaq Computer Corp. provides its standard three-year, parts-and-labor warranty with the Contura line, and that includes one year of free on-site service. —Oliver Rist

CompuAdd Express

CompuAdd Express 425XL

CompuAdd Express 425Color

CompuAdd Express 425ColorPlus

CompuAdd Express offers a mixed bag with its latest trio of active color, passive color, and monochrome systems. Despite travel weights just shy of 8 pounds, left-handed trackballs, marginal Battery Rundown times, and slow Cyrix 486SLC/

Compaq Contura 4/25

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **ABOVE AVERAGE**

Technical support **ABOVE AVERAGE**

Compaq Contura 4/25CX

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **GOOD**

Desktop replacement **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **ABOVE AVERAGE**

Technical support **ABOVE AVERAGE**

Compaq Contura 4/25C

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **ABOVE AVERAGE**

Repair service **ABOVE AVERAGE**

Technical support **ABOVE AVERAGE**

Hewlett-Packard
and Microsoft are
about to change
the way business
travelers work.



Dimensions (closed):
1.4" high x 11.1" wide
x 6.4" deep.

Weight: Less than
3 pounds: flash disk
model lighter.

Processor: 386SXLV
CPU.

Display: 640- x 480-dot
VGA; 9-inch LCD;
16-level gray scale.

**Available PCMCIA
Version 2.0 slots:**
Flash disk model: 2 slots.
Hard disk model: 1 slot.

RAM: 2 MB expandable
to 8 MB with optional,
user-installable RAM
expansion card.

I/O: 115k-baud serial
RS-232, serial infrared
and parallel. Optional
2400-baud data; 9600-
baud send/receive fax/
modem.

Actual size ►



Introducing the HP Omni

It's the best thing going for people who travel on business. Because it's the lightest full-function PC with a full-size keyboard. And it's loaded with all the features busy travelers need to take with them.



At less than 3 pounds, it lets people on the go breeze through airports. Measuring a sleek 1.4" x 11.1" x 6.4", the HP OmniBook 300



won't slow business travelers down. And their fingers can move across those familiar keys just as fast as on their office PC. Because the keys are the same size.

With 9 hours of battery life, travelers can keep on going. That's continuous use of the flash disk model. (Flash disk cards, with no moving parts, greatly increase battery life, as well as reliability.) And the battery pack recharges in less than 1.5 hours. Or drop in four AA batteries. Even the hard disk model lasts 5 hours between charges.

Built-in mouse saves space, works anywhere. Press a button. Out comes the mouse. It's not a ball or a stick. There's nothing extra to connect. It's a genuine mouse. And it pops up to make it as easy to handle as the ones people are used to working with. Which helps make working on the road as productive as in the office.



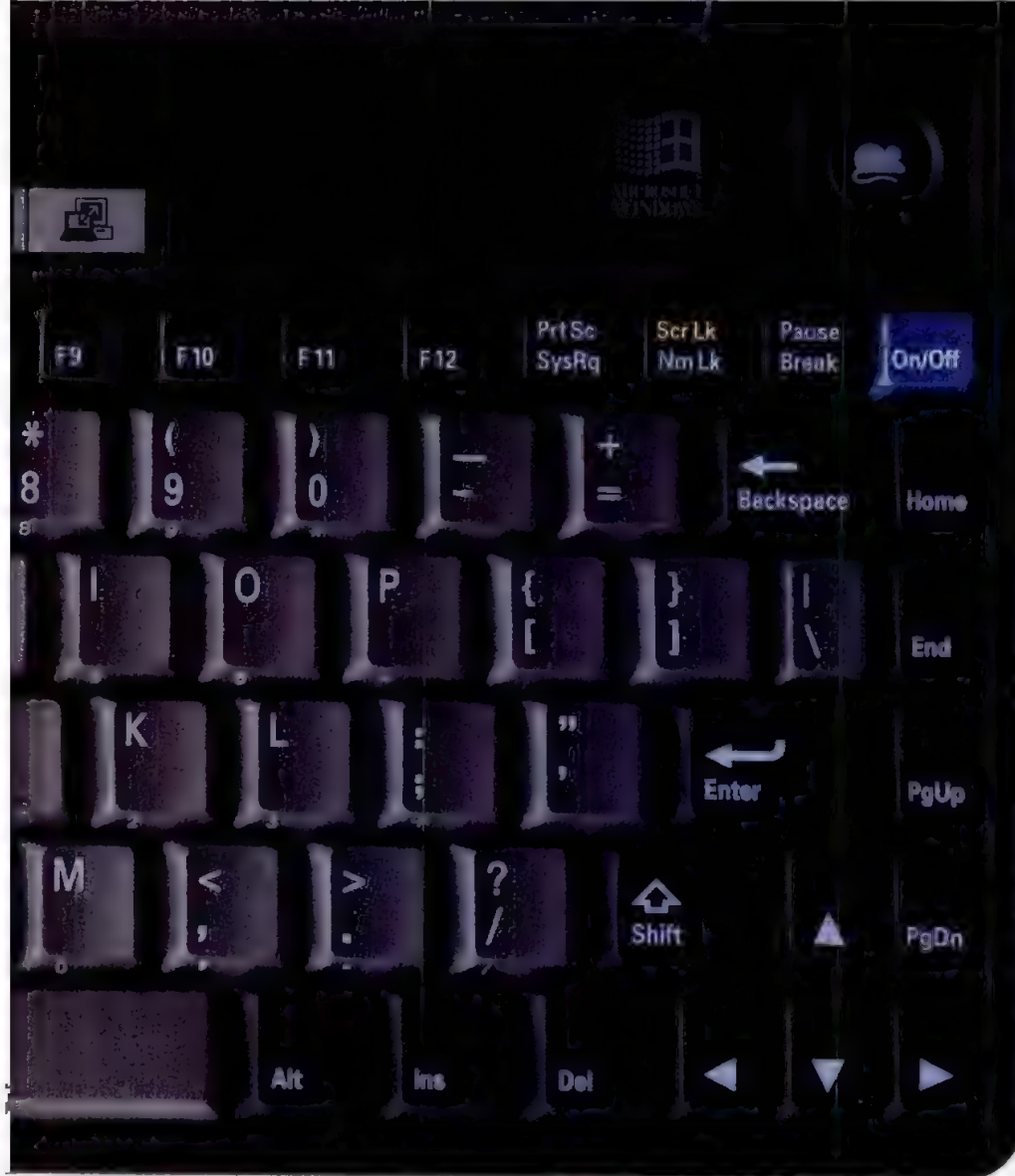
Microsoft® applications built into ROM. Being built into ROM makes all the difference. It means Microsoft Word, Excel and Windows™ 3.1 come up instantly on the 9-inch LCD screen. No disk space wasted. No time lost booting. Or going in and out of applications. Instead, hit one function key and you're in business.

To add more MS-DOS® or Windows-compatible software, just load away.

It turns on instantly in the same place it's turned off.

Although this super-portable turns completely off to save battery life, it keeps track of the last screen. And that's where it turns on again. It doesn't even have to boot up.





"The HP OmniBook 300's mouse is the single best one since the desktop mouse."

— Jeffrey Henning, Industry Analyst
BIS Strategic Decisions

"Finally, a smaller notebook without compromises. Kudos for HP!"

— Randal Giusto, Senior Analyst,
Workgroup Technologies

"HP clearly has the lowest weight in a Windows machine and pretty snappy performance."

— Kimball Brown, V.P., InfoCorp

"Having applications in ROM should help tremendously with both freeing up disk space and improving battery life."

— Janet Cole, Industry Analyst,
Dataquest

Book 300 Superportable PC.

The HP OmniBook 300 can also be an organizer. An appointment and address book. An alarm clock. A calendar. A calculator. A link with the office PC. With options, a fax and an e-mail terminal.

The price to lighten the workload? Just \$1,950* for the hard disk model. \$2,375* for the flash disk model.

For more information or the name of your nearest HP OmniBook 300 dealer, call 1-800-443-1254, Dept. 236. It's going to make a lot of workloads lighter. Including yours.



**HEWLETT
PACKARD**

■ Multimedia on the Go

by Christopher Barr

The melding of video and audio technology with computer technology is practically a fait accompli. Multimedia, though still experiencing growing pains, is providing sizzle for the 1990s. But lugging a computer, monitor, CD-ROM

drive, speakers, cables, and various interface boards is akin to carrying car seats and paraphernalia for children—necessary but cumbersome. These three portables, though, are nowhere near our upper limit of 9 pounds. Rigged with multimedia components, they provide the state of the art in mobile sound and video. Since multimedia demands significant computing resources from the processor and I/O systems, all these portables are A/C-powered.

These high-end systems use the latest in active-matrix LCD screen technology, large hard disks, and powerful processors. They can show off an outstanding sales presentation—complete with a stereo soundtrack—or demonstrate software. Most have either full-motion video boards or expansion slots that can be used for real-time video-capture boards. They also have CD-ROM drives, which can store large data sets, but they are not the only portables that do: Scenario

Inc., of Newton, Massachusetts (617-965-6458), has a line of battery-operated portables that combines either a Sharp or a Texas Instruments notebook with a CD-ROM drive. Scenario's systems weigh about 10 pounds each. Micro Express, of Santa Ana, California (800-

ports, the 486c has two full-length internal EISA slots for sound or video-capture boards. Housed in a rugged attaché case, the Portable 486c is a 17.6-pound A/C-only computing powerhouse with a dazzling 10.4-inch thin-film transistor (TFT) active-matrix LCD panel which

can provide 640-by-480 resolution with 256 colors. Although it comes standard with a 210MB hard disk, a 525MB hard disk is available.

The Portable 486c comes with a parallel, a serial, and an external VGA, mouse, and PS/2-keyboard port, and it will take a proprietary internal modem or an additional serial port. The two expansion ports are useful for external drives such as CD-ROMs, hard disks, 5.25-inch floppy disks, or tape.

The machine also comes with a detachable 101-key keyboard, a Compaq mouse, and 4MB of RAM—which can be upgraded to 32MB.

Compaq has a CD-ROM option

that connects to a proprietary SCSI-2 expansion port. In lieu of using this option, we attached an NEC MultiSpin 38 CD-ROM to the parallel port. Unfortunately, the parallel port could not provide the throughput to provide adequate bandwidth to run Microsoft's Video for Windows. While either CD-



The Toshiba T6400MM combines a bright 10.4-inch active matrix color screen with the power of a 486DX2/50 processor and the capability to prepare full-motion video presentations.

The elegant solution to multimedia on the road, Dolch's MACH incorporates the technology of a full-powered desktop system into a rubber-covered carrying case.

Compaq's Portable 486c/66, with its EISA bus architecture and 486DX2/66 CPU, is an excellent platform with which to process sight and sound on the road.

989-9900), has a multimedia A/C-powered portable with a CD-ROM drive at a weight close to 30 pounds.

COMPAQ PORTABLE 486c/66

The Compaq 486c/66 can be fitted with enough peripherals to make it sing and dance. Besides a full complement of

ROM option is an external solution (Dolch's CD-ROM is internal), the drive is easily transported.

► FACT FILE

Compaq Portable 486c/66
Compaq Computer Corp.;
800-345-1518.

Base price: \$6,999.

Circle 501 on reader service card

DOLCH MACH

Dolch's MACH (Modular Adaptive Computing Hardware) is the perfect exercise in power, elegance, and multimedia portability. This 18-pound rubber-covered system contains top-of-the-line components.

The base system comes with a range of 486 processors, from an SX/25 to a DX2/66, along with 128K write-back hardware cache, 4MB of RAM (expandable to 32MB), a 1.44-inch floppy disk drive, and a 120MB hard disk. All versions use a 10.4-inch TFT active-matrix LCD panel, with a Viper video board capable of 640-by-480 resolution with 24,000 colors.

The model we tested came with the Media-MAVEN option, which includes a Sony CD-ROM drive and 16-bit Pro AudioSpectrum sound card. It also contained a Video-MAVEN full-motion video board and the hard disk was upgraded to a Quantum ProDrive LPS 512MB SCSI hard disk. It came with 8MB RAM, a Microsoft mouse, MS-DOS 6.0, and a soft-sided nylon carrying case.

The MACH provides the power, convenience, and upgradability needed for multimedia. The Video-MAVEN full-motion video board uses a Chips and Technology chip set, offers 185,000 colors, and accepts NTSC or PAL to provide video overlay, but it won't let you capture and compress the incoming image.

► FACT FILE

Dolch MACH
Dolch Computer Systems;
408-957-6575.

Base price: \$9,587.

Circle 502 on reader service card

TOSHIBA T6400MM

Toshiba's entry into the multimedia portables horse race is the T6400MM clamshell. It comes with 4MB of RAM (upgradable to 36MB), a 200MB hard disk drive, a Mambo DVI board, from MediaShare, and external Altec Lansing speakers. The T6400MM uses a 10.4-inch TFT active-matrix color LCD panel, and the entire 13-pound package comes in a Samsonite case—for \$7,999.

Using an Intel DX2/50, it is AC-only and measures 15.4 by 10.5 by 4.1 inches with a removable 101-key keyboard. It has a stunning color panel, which can produce 640-by-480 resolution with 185,000 colors. The T6400MM will take an internal proprietary modem and comes with a 16-bit ISA slot as well as the following ports: serial, parallel, PS/2 mouse, PS/2 keyboard, external VGA for simultaneous viewing, external floppy disk drive, and proprietary 150-pin expansion port.

However, it lacks a CD-ROM drive. There are three ways to add one: attach a SCSI adapter to the expansion port, remove the 3.5-inch floppy disk drive and replace it with a small form-factor CD-ROM drive, or attach a CD-ROM drive to the parallel port. We chose the last method and attached an NEC MultiSpin 38 drive.

For sound and video fury, the T6400MM comes with the Mambo DVI card. Based on the Intel i750 chip set, the card facilitates video playback in stereo sound at 30 frames a second. While effective for Intel DVI files, the version used would not play Windows .WAV audio files. (A driver to play .WAV files should be coming from Toshiba soon.) The Mambo card also has a 10BaseT Ethernet connector and another external VGA connector to view the DVI files, which don't show up on the other external VGA display. □

► FACT FILE

Toshiba T6400MM
Toshiba America Information Systems
Inc.; 800-334-3445.
List price: \$7,999.

Circle 503 on reader service card

25 processors, the CompuAdd Express 425ColorPlus, 425Color, and 425XL sport top-technology displays and aggressive prices at \$3,895, \$2,595, and \$1,895, respectively.

The most distinguishing feature among the three was the display. The 425Color-

Plus and 425Color notebooks have beautiful 8.5-inch diagonal active- and passive-matrix displays, respectively. Easily readable at any angle, the 425ColorPlus Sharp display supports 256 bright, clear colors at 640-by-480 resolution.

Less distinct but still vibrant is the Sanyo screen of the 425Color. Although it is not easy to read from all angles, this passive-matrix display is

easier on the eyes than many others of its kind (including the DECpc 325SLC). With a 9.5-inch diagonal Sharp screen, the 425XL has a crisply contrasted screen and provides 64 shades of gray at 640-by-480 resolution. Even with solid DOS-based video scores, two of the three systems, the 425Color and 425XL, still garnered the worst DOSmark scores in the 486SLC/25 category. In fact, the 425ColorPlus with its Cirrus Logic chipset had the highest DOS-based video score of all and performed adequately in the 486SLC/25 category. Each system has either knobs or sliding dimmers to the

right of the screen for brightness and contrast control and can display simultaneously with a full-sized monitor.

CompuAdd Express 425Color

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

CompuAdd Express 425XL

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

CompuAdd Express 425ColorPlus

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

FACT FILE

CompuAdd Express 425XL

CompuAdd Express 425Color

CompuAdd Express 425ColorPlus

CompuAdd Express, 12301 Technology Blvd.
Austin, TX 78727; 800-925-3000,
512-219-1800; fax, 512-219-2890



CompuAdd Express 425XL, CompuAdd Express 425Color,
CompuAdd Express 425ColorPlus

List price: 425XL, \$1,895; 425Color, \$2,595; 425ColorPlus, \$3,895.

Tested configuration: 4MB 80-ns RAM (425XL), 8MB 80-ns RAM (425Color and 425ColorPlus), 128MB Seagate ST9144A IDE hard disk (425XL and 425Color), 208MB Seagate ST9235A SCSI-II hard disk (425ColorPlus), 1.44MB floppy disk drive, BitFax fax modem software, 9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, built-in trackball, LotusWorks 3.0 integrated application software, Close-up 4.0 customer/terminal program.

Options: 4MB upgrade, \$150 (425XL); 16MB upgrade, \$600; extra nickel cadmium battery, \$69; Xircorn LAN adapter, \$330; battery charger, \$49; extra AC adapter, \$49; keyboard adapter, \$6.

In short: The CompuAdd Express family of portable computers reviewed here are distinguished by their attractively low price tags, high-quality displays, and the company's useful on-line remote-diagnostics service. The performance of these machines was disappointing, however.



ON READER SERVICE CARD

have to verify the change. The color laptops have 8MB of RAM (expandable to 20MB) standard, and the monochrome unit, only 4MB (expandable to 8MB or 20MB).

The almost indistinguishable brown matte exteriors of the three laptops conceal nickel cadmium batteries—the 425XL lasted 2.5 hours on the Battery Rundown test, while the others turned off about an hour earlier. The trio also contain 9,600-bps data/fax modems.

While the 425Color and 425XL units

had 128MB hard disks, the 425ColorPlus contains a 208MB hard disk—ranked 26th overall among all systems tested—and a SCSI-II interface. This makes the CompuAdd Express 425ColorPlus a rarity in the portable PCs World—a notebook

that can be connected to a CD-ROM or tape backup.

Each CompuAdd system had limited power management features. Power-down was only adjustable on the hard disk—1 to 15 minutes or disabled. Screen power-down was limited to either “enable” or “disable.” ZDigit scores ranged from a typical 3 hours 35 minutes (425XL) to a deficient 1 hour 47 minutes (425Color). All lacked PCMCIA slots but came with free carrying cases.

The CompuAdd Express 425ColorPlus, 425Color, and 425XL have extremely helpful Remote Rescue on-line technical support, toll-free support, Monday to Friday, from 9 a.m. to 9 p.m. Eastern time, and a one-year limited warranty covering replacement or repair.

—Camille N. Cline

Compudyne

Compudyne 4SL/25 Subnote

Despite the somewhat reduced expectations of subnotebook buyers, the Compudyne 4SL/25 Subnote still ends up as a bit of a disappointment.

Priced at \$2,138, and powered by

Compudyne 4SL/25 Subnote

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW
AVERAGE**

Repair service **BELOW
AVERAGE**

Technical support **BELOW
AVERAGE**

Intel's 25-MHz 486SL chip, the 4SL/25 Subnote was out-performed by all of the other reviewed machines in its processor class.

The 7.5-inch passive-matrix monochrome screen is small and difficult to read from an angle. Contrast and brightness controls are embedded in the

function keys and can be awkward to use. Like other subnotebooks in this test, the



FACT FILE

Compudyne 4SL/25 Subnote

Compudyne, 15167 Business Ave., Dallas,
TX 75244; 800-862-3099, 214-702-0055;
fax, 214-888-5743

List price: \$2,138.

Tested configuration: 4MB 70-ns RAM, 80MB Toshiba MK1422FC IDE hard disk with 32K buffer, external 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, built-in trackball, Lotus Organizer 1.0 software.

Options: Extra 80MB hard disk, \$389; 4MB RAM upgrade, \$279; extra nickel hydride battery, \$129; external 1.44MB floppy drive, \$119; extra fast charge adapter, \$89; extra compact AC adapter, \$59.

In short: Compudyne is keeping the price of this easy-to-carry subnotebook down while offering some innovative ideas. Unfortunately, the Compudyne 4SL/25 Subnote lacks processing power, its keyboard is cramped, and its small, 7.5-inch passive-matrix display is sometimes difficult to view.



ON READER SERVICE CARD

Memory scores were low both within the 486SLC/25 group and outside it, perhaps due to the lack of caches. Upgrading memory is as easy as unscrewing a clearly marked back panel, snapping in a module, closing it up, and letting Setup reconfigure the system. The system detects the change in memory, but you

486SL/25 Subnote uses an external floppy disk drive.

On PC Labs' performance tests, the unit finished in last place in all categories for its CPU group, except for the DOS and Windows disk tests, where it only managed to notch 10th place of the 11 486SL/25 machines tested.

The Subnote has a cramped keyboard layout and small function keys as well. At just over three pounds—and a road weight of 5.4 pounds including the floppy drive—it is a light, easy-to-carry subnotebook. Another plus is battery life: The Subnote lasted 2 hours 48 minutes on our Battery Rundown test and 3 hours 7 minutes on our ZDigit test with its power-conservation features enabled.

At \$2,138, the Subnote is certainly inexpensive for a 486SL-based subnotebook, but the unit's light weight and decent battery life don't do enough to compensate for the machine's poor overall performance.—*Michael Bonomo*

Dell Computer Corp.

Dell 325SLi

The Dell 325SLi subnotebook isn't for everyone. With a system weight of 3.7 pounds, it is very light; with its floppy disk and travel-ready, it weighs only 5.6 pounds. And its \$2,264 price is not bad for a 386SL/25 subnotebook.

Dell 325SLi	
SUITABILITY TO TASK	
Road warrior	EXCELLENT
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Unfortunately, the downside is its screen. The SLi has a monochrome reflective display, which may save on weight and increase battery life but which doesn't help image quality. In some lighting conditions, at an angle and after extended viewing, it is more difficult to distinguish objects on the screen. Dell's heavier but comparably priced 386-based N and NL lines both offer backlit passive-matrix screens in monochrome and color.



FACT FILE

Dell 325SLi

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-343-3643

List price: \$2,264

Tested configuration: 6MB 80-ns RAM with 16K of external cache, 213MB Toshiba MK-2224FC IDE hard disk with 128K cache, 2,400-/9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, Microsoft BallPoint Mouse.

Options: 2MB RAM upgrade, \$100; 4MB RAM upgrade, \$200; 8MB RAM upgrade, \$400; extra nickel hydride battery, \$99; math coprocessor, \$149; battery charger, \$149

In short: Light and packaged for the road, the Dell 325SLi Subnotebook boasts good battery life and performance. Among tested portables with Intel 386SL/25 CPUs, its PC Labs' memory, disk, and DOSmark scores were in first place. The lack of a backlit screen mars image quality, however.

ON READER SERVICE CARD

On the other hand, the SLi comes with a PCMCIA Type II slot and has a Battery Rundown test time of 2 hours 55 minutes. Its keyboard has 12 half-size function keys, with separate Home, End, PgUp, and PgDn keys. Its cursor keys are arranged in the popular inverted-T layout, and key travel was good. The screen folds back past 180 degrees, allowing for simultaneous display with an external VGA monitor. But there's no built-in trackball.

Across our suite of performance tests, the Dell 325SLi came in with average to below-average marks. Within its CPU group, however, the portable's memory, disk, and DOSmark scores were in first place.

Dell offers a one-year warranty with the SLi, which includes first-year on-site service.—*Anush Yegyzarian*

Dell Computer Corp.

Dell 325N

Dell 325NC

The Dell 325NC (\$3,298) and Dell 325N (\$2,798) are the Dell Computer Corp.'s high-end notebook offerings reviewed for this roundup, although both are powered by aging 386 chips. Shortly after

Dell 325N

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

this review was completed, the company announced that it had ended production of the 325N. Availability of this model depends on the company's existing stock. Also, Dell said that it would no longer offer the 208MB hard disk used in testing these notebooks.

Unfortunately, these machines' incredible battery scores don't do enough to outweigh their mushy keyboards, so-so displays, and high price tags. Hotkeys let you enhance the video contrast, display the battery charge, and perform a number of other functions.

Power-saving features include four processor speeds, and the units can be configured to scale down automatically.

There's no built-in pointing device, but a Microsoft BallPoint Mouse is supplied. You can attach the mouse to either side of the keyboard, although, if placed on the right, the mouse can block access to the floppy disk drive.

The keyboard

Dell 325NC	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



FACT FILE

Dell 325N

Dell 325NC

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-343-3643

List price: 325N, \$2,798; 325NC, \$3,298.

Tested configuration: 208MB Seagate ST3235A IDE hard disk with 64K buffer, 4MB 70-ns RAM with 64K external cache, Microsoft BallPoint mouse, 9,600-bps data/fax modem, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, \$100; 4MB RAM upgrade, \$200; 8MB RAM upgrade, \$400; extra battery, \$169; math coprocessor, \$149; battery charger, \$269; carrying case, \$39.

In short: The lack of a 486 processor in what Dell sells as its high-end line of notebooks is a disappointment, although superior battery times and quality construction are positives. The 325NC has a reasonably good passive-matrix color display, though it doesn't approach the richness of active-matrix color screens, and the 325N offered a passable monochrome display. The ability to change the screen font is a nice touch. Note that Dell recently announced that it had ended production of the 325N. Also, the 208MB hard drive sent for testing is no longer being offered.



is a bit mushy, though adequate. Certain keys can be used to simulate a mouse, but this option is not easy to use.

The cursor keys are positioned in an inverted-T layout on the lower right-hand side of the keyboard.

The 325NC has a passive-matrix color display. Edge-lighting improves evenness and contrast, but the screen is still not as clear and bright as active-matrix color.

The screen quality of the monochrome 325N is adequate. Contrast could be better, but the ability to switch the system font aids greatly in readability. Both

machines delivered some of the best Battery Rundown and ZDigit Rundown scores of all systems we tested. The 325N lasted 3 hours 53 minutes on the Battery Rundown test, while the 325NC stopped one hour short of that time. With power-saving features in gear, the monochrome unit ran for an astounding 7 hours. The 325NC turned in an equally impressive score of 5 hours 31 minutes.

Both models support flash BIOS, and new BIOS versions can be downloaded from CompuServe (GO DELL) or Dell's own BBS as they become available. Dell's technical support is available 24 hours a day.—Sheryl Canter

Dell Computer Corp.

Dell NL25

Dell NL25C

The Dell NL25 (\$1,949) and Dell NL25C (\$2,449), from Dell Computer Corp., are the company's budget-line notebooks. These units are basically average-priced 386-based machines with only the bare essentials.

Many of the options that are featured in Dell's mainstream line of notebook

Dell NL25	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	POOR
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

computers—the 325N and the 325NC—are missing from these two offerings. There is no reverse-video mode available; the monochrome NL25 system is set permanently to black text on a white background.

You also cannot cycle through different text fonts; only one system font is provided. And finally, only two levels of processor speed are supported, rather than the four offered by the 325N.

The NL25C has a backlit passive-matrix color display, the image quality of which has some noticeable drawbacks. The colors tend to be both faded and un-

even, and you can also see shadow images around the graphics boxes in Microsoft Windows.

The display screens on both the NL25 and the NL25C fold all the way back, making the machines easy to use with an external monitor.

For both of the Dell lines, the supplied pointing device is a Microsoft BallPoint serial mouse, which—if mounted on the right side—interferes with access to the floppy disk drive. A simulated mouse is embedded in the keyboard, but it is awkward to use—for emergencies only.

The keyboard is the same as that used in the 325N: somewhat mushy, but adequate. A setup option lets you add or remove an audible keyboard click.

Unlike their higher-priced counter-



FACT FILE

Dell NL25

Dell NL25C

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-343-3643

List price: NL25, \$1,949; NL25C, \$2,449.

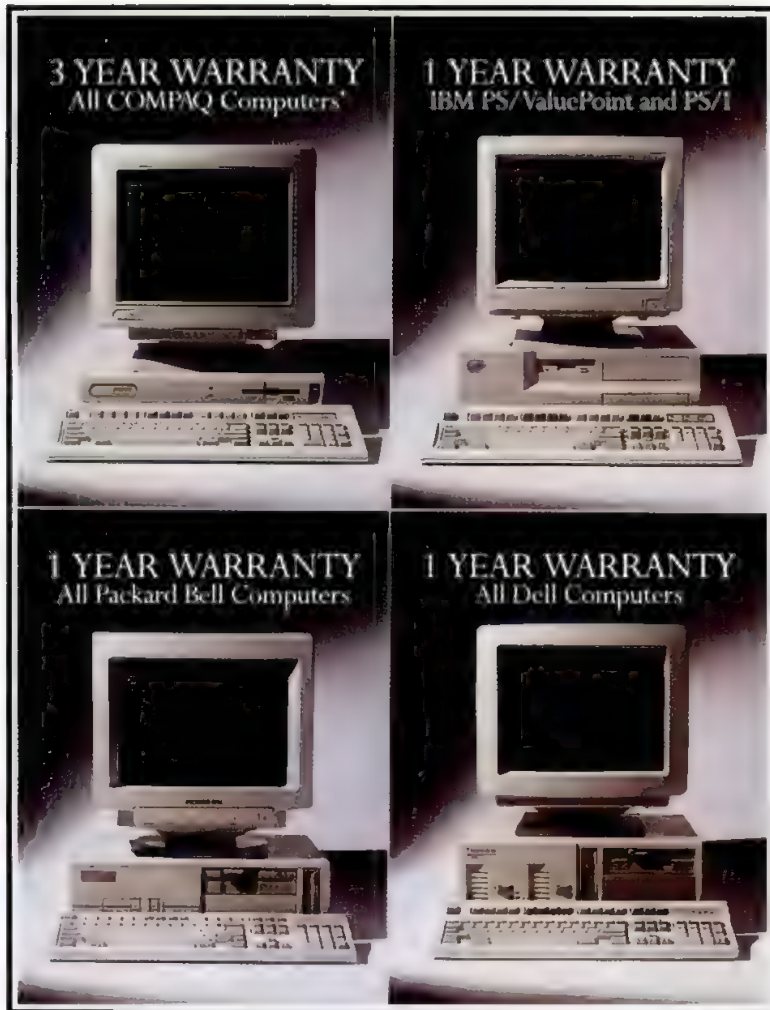
Tested configuration: 115MB Seagate ST9144A IDE hard disk with 64K buffer, 4MB 80-ns RAM with 64K external cache, Microsoft BallPoint Mouse, 14,400-/9,600-bps data/fax modem (NL25), 9,600-bps data/fax modem (NL25C), 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, \$100; 4MB RAM upgrade, \$200; 6MB RAM upgrade, \$300; extra battery, \$99; math coprocessor, \$149; battery charger cradle, \$29.

In short: Inexpensive and rugged, the NL25 has reasonably good battery times and good performance for a 386 system. The passive-matrix color screen of the NL25C does not measure up to others in this review, but its level of performance and battery times do.



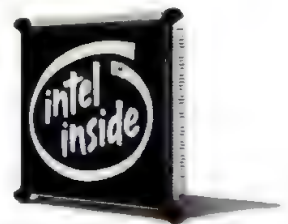
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CIRCLE 240 ON READER SERVICE CARD

parts, the NL25 and NL25C turned in average battery scores. On the ZDigit Rundown test with power saving enabled, these units showed their use of rudimentary power management. The NL25 ran out of juice after 3 hours 16 minutes while the NL25C came in at 3 hours 1 minute. On the Battery Rundown test, the NL25 averaged 2 hours 43 minutes and the NL25C averaged 2 hours 19 minutes.

Dell NL25C	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

As with the 325N, the flash BIOS is upgradable. (New versions are available on CompuServe or from Dell's BBS).

Technical support is available 24 hours a day and is backed with a guaranteed waiting time of no more than 5

minutes. If you have to wait any longer than that, Dell will send you \$25.

—Sheryl Canter

Epson America Inc.

Epson ActionNote 4SLC/25

If low cost is more important than sheer performance or a color display, consider the monochrome \$1,649 Epson ActionNote 4SLC/25. Based on a Cyrix CX486SLC/25 chip, the ActionNote comes with an internal data/fax modem and decent power-management features.

This unit lacks some of the expansion abilities of other notebooks, but adding up to 6MB of RAM is easy. The Hitachi screen tilts back to only

Epson ActionNote 4SLC/25	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	BELOW AVERAGE



FACT FILE

Epson ActionNote 4SLC/25

Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-922-8911, 310-782-0770; fax, 310-782-5225

List price: \$1,649 (estimated street price).

Tested configuration: 131MB Areal A120 IDE hard disk with 32K cache, 4MB 70-ns RAM, Logitech trackball, 2,400-/9,600-bps data/fax modem, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 6MB RAM upgrade, \$399; extra nickel cadmium battery, \$79; 2,400-/9,600-bps data/fax modem with BitCom and WinFax Lite software, \$219; external keyboard, \$69; 12-volt battery adapter, \$129.

In short: While lacking PCMCIA slots and powered by a less-than-awe-inspiring Cyrix CX486SLC/25 processor, the Epson ActionNote 4SLC/25 nevertheless provides a well-engineered product for a good price. Battery life wasn't stunning, but the unit's keyboard and its lightness may make it a good notebook option for tight budgets.

ON READER SERVICE CARD

about 120 degrees, which may limit use with an external monitor.

The ActionNote's travel weight is 7.1 pounds. The firm 84-key keyboard (85 with the space bar) has ten separate function keys and separate Home, End, PgUp, and PgDn keys.

Raw performance is not the ActionNote's strength. On our benchmark tests, the ActionNote performed consistently in the lower half of this roundup, save for an above-average disk score and an average video score. Even among its CPU peers, the ActionNote performed slightly below average.

On the Battery Rundown test, the ActionNote 4SLC/25 lasted just 1 hour 45 minutes, and 2 hours 2 minutes on the ZDigit Rundown test. The portable's power-management functions let you enable separate timeout counters for the

display, hard disk, and system.

The ActionNote carries a 1-year warranty, which includes on-site service.

—Catherine Kunkemueller

Ergo Computing Inc.

Ergo PowerBrick 486

The Ergo PowerBrick 486, from Ergo Computing, is a value-oriented notebook with relatively low weight and a built-in trackball. At \$1,995 with 4MB of RAM and a 120MB hard disk, the PowerBrick is a low-priced 486DX/33 notebook.

The PowerBrick weighs 6.7 pounds with its nickel cadmium battery. Most notebook batteries have a higher amperage rating, a factor limiting the PowerBrick's Battery Rundown test result to 1 hour 56 minutes and its ZDigit Rundown



FACT FILE

Ergo PowerBrick 486

Ergo Computing Inc., One Intercontinental Way, Peabody, MA 01960; 800-633-1925, 508-535-7510; fax, 508-535-7512

List price: \$1,995.

Tested configuration: 4MB 70-ns RAM, 120MB Quantum IDE hard disk with 64K cache, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, mouse, Magic Cursor.

Options: 200MB hard disk upgrade, \$200; 350MB hard disk upgrade, \$700; 4MB RAM upgrade, \$195; 16MB RAM upgrade, \$1,495; upgrade to 486DX2/66, \$300; 2,400-/9,600-bps data/fax modem, \$149.

In short: While the unit puts an emphasis on user comfort, with its integrated trackball situated in the middle of the wrist rest, the \$1,995 Ergo PowerBrick is otherwise a typical albeit low-cost 486DX 33-MHz monochrome notebook. Its battery, with a lower amperage rating than most, lagged on our Battery Rundown test.

ON READER SERVICE CARD



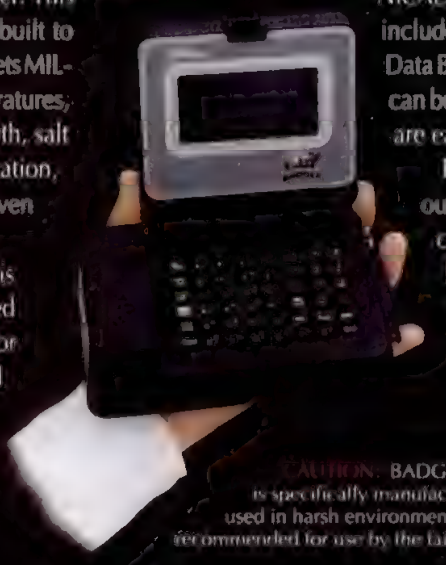
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The BADGER GT-110 can be powered by a standard 9-volt alkaline or lithium battery, three 2/3A lithium batteries or a NICAD rechargeable battery pack. Built-in utilities include GT Shell, Communications, Text Editor, Data Base and Forms Manager. Application software can be downloaded from any DOS PC and data files are easily exchanged.

BADGER GT-110 is setting a new standard in outdoor computing. This tough, combat ready computer is now available at commercial prices below \$2,000. For more information call 1-(800)-3-BADGER.



CAUTION: BADGER GT-110 is specifically manufactured to be used in harsh environments. It is not recommended for use by the faint-hearted.



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CIRCLE 390 ON READER SERVICE CARD

Battery Life vs. Portability

Eight out of the 68 systems we tested were able to combine a travel weight of under 7.5 pounds and a battery that lasted for 3 hours or more. They stand out as road warriors of distinction.

For notebooks, long battery life and light weight are a traveler's ideals. Of the 68 systems reviewed, only 3 combined a travel weight of under 7.5 pounds with battery life of 4 hours or more. Another 5 fell in the 3- to 4-hour range, but none had color displays. (Note that our system weight includes battery weight, while the travel weight adds the AC adapter and power cord but

not the external floppy disk drive that may come with a subnotebook system.)

The ZDS Z-Note 425Ln Model 120, the TI TravelMate 4000 WinSX/25, and the DECpc 425SL had the longest Battery Rundown times among sub-7.5-pound units. For true lightweights, battery life is often sacrificed. Yet the featherweight Dell 325SLi, at 4.8 pounds, ran for 2 hours 55 minutes.

Color systems still weigh more and use more power than monochrome. The TI TravelMate 4000 WinSX/25 Color and WinDX2/40 Color weigh about 7.5 pounds each and had Battery Rundown times of about 2 hours 15 minutes.

Compaq's Contura 4/25C and LTE Lite 4/25C are a little heavier, with battery life of about 1 hour 50 minutes each. The Poly NB425C—at 7.2 pounds, the lightest passive-matrix color system—has a battery life of 1 hour 44 minutes. In the same category, the AST PowerExec EL Color and Hyundai Courier Spectra have even shorter battery lives but remain relatively light for color units.

Active-matrix color adds to the weight. The AST PowerExec 4/25SL Color Plus, IBM ThinkPad 720C, NEC UltraLite Versa 25C, and ZDS Z-Note 425Lnc all provide roughly 2 to 3 hours of battery life and weigh 8 to 9 pounds.



COVER STORY

Portable PCs

	2Digit cycle used for testing (minutes)*	2Digit Run-down time (hours: minutes)	Rank	Battery Run-down time (hours: minutes)	Rank	Battery weight (pounds)	Rank	Battery life per pound (hours: minutes)	Rank	System weight (pounds)	Rank	Travel weight with adapter (pounds)	Rank	
AST PowerExec EL Color (386SL/25)	3:30	04:51	21	01:54	68	1.4	44	01:01	62	6.4	32	7.7	28	
AST PowerExec 3/25SL Color (386SL/25)	3:30**	04:44	14	01:51	61	1.5	51	01:03	61	6.8	48	8.1	47	
AST PowerExec 4/25SL Color Plus (486SL/25)	3:30**	06:17	7	01:14	38	1.6	60	01:24	48	7.1	10	8.1	47	
Aurum GoldNote DX2-50 (486DX2/50)	3:30	01:47	64	01:34	63	1.1	14	01:29	46	6.8	43	8.3	54	
Blue Star 486DX2/66 (486DX2/66)	3:30	02:44	45	01:55	45	1.2	22	01:37	41	8.4	17	8.7	64	
CAF AquaLITE II (Am386SXL/25)	3:30	01:01	48	01:04	75	1.1	14	02:21	16	5.5	8	6.9	6	
Compaq Contura 4/25 (486SL/25)	3:30	03:42	18	02:24	18	1.1	14	02:13	19	6.3	29	7.4	19	
Compaq Contura 4/25C (486SL/25)	3:30	01:01	48	01:04	75	1.1	14	01:54	42	6.5	37	7.7	28	
Compaq Contura 4/25CX (486SL/25)	3:30	01:01	41	01:05	76	1.3	26	01:16	58	6.9	52	8.0	40	
Compaq LTE Lite 25E (386SL/25)	3:30	01:01	47	01:07	78	1.3	26	02:16	17	6.5	38	7.3	17	
Compaq LTE Lite 4/25C (486SL/25)	3:30	01:01	13	01:01	50	1.3	26	01:26	47	6.8	40	7.8	30	
CompuAdd Express 425Color (C486SLC/25)	3:30	01:41	50	01:35	61	1.1	14	01:23	43	6.5	37	7.8	31	
CompuAdd Express 425ColorPlus (C486SLC/25)	3:30	01:01	12	01:01	50	1.1	14	01:21	54	6.6	40	8.0	40	
CompuAdd Express 425XL (C486SLC/25)	3:30	01:01	3	02:30	27	1.1	14	02:11	20	6.7	45	7.6	25	
Compudyme 4DX2/66 Active TFT Color Slimnote (486DX2/66)	3:30	N/A		01:03	46	1.5	51	01:01	62	6.7	45	8.2	50	
Compudyme 4DX2/66 Monochrome Slimnote (486DX2/66)	3:30	N/A		01:03	46	1.5	51	02:09	21	6.7	46	7.8	31	
Compudyme 4SL/25 Subnote (486SL/25)	3:30	N/A		01:01	50	1.1	6	03:19	5	3.0	1	5.4	4	
Dell NL25 (386SL/25)	3:30	01:01	48	01:43	53	1.3	26	02:02	23	6.4	42	8.0	40	
Dell NL25C (386SL/25)	3:30	01:01	41	02:19	33	1.4	44	01:43	40	6.7	40	7.9	37	
Dell 325N (386SL/25)	3:30	01:01	5	01:01	50	1.6	60	02:27	15	6.5	39	7.6	25	
Dell 325NC (386SL/25)	3:30	01:01	10	01:02	51	1.6	60	01:49	34	7.3	14	8.3	54	
Dell 325SLi (386SL/25)	3:30	N/A	-	01:01	50	0.7	1	04:14	1	3.7	2	4.8	1	
Digital DECpc 325SL (386SL/25)	3:30**	08:33	2	01:41	54	1.5	51	02:27	15	6.3	29	7.6	25	
Digital DECpc 325SLC (386SL/25)	3:30	01:01	12	01:01	50	1.5	51	01:33	44	6.9	52	8.2	50	
Digital DECpc 425SL (486SL/25)	3:30**	09:14	1	01:01	50	1.5	51	02:42	11	6.3	29	7.4	19	
Epson ActionNote 4SLC/25 (C486SLC/25)	3:30	01:01	63	01:47	54	0.8	3	01:11	55	5.5	8	7.1	14	
Ergo PowerBrick 486 (486DX/33)	3:30	01:04	41	01:56	47	1.4	44	01:23	49	6.1	7	8.4	61	
Gateway Nomad 425SXL (486SX/25)	3:30	06:46	6	02:09	34	1.3	26	01:15	56	6.7	46	6.9	6	
Gateway Nomad 450DXL (486DX2/50)	3:30	01:01	4	01:01	50	1.2	22	01:23	43	6.6	40	6.9	6	
GRiD Convertible (386SL/25)	3:30	01:01	1	01:07	77	0.3	3	02:06	1	5.7	15	7.2	15	
HyperBook 2300DLC/40 (C486DLC/40)	3:30	01:42	59	01:01	50	1.3	26	01:12	57	6.9	52	8.3	54	
HyperBook 2300DX2/50 (486DX2/50)	3:30	N/A		01:41	54	1.4	26	01:19	53	6.9	52	8.3	54	
Hyundai Courier (Am386SXL/25)	3:30	01:02	48	01:01	49	1.0	9	02:03	26	6.7	46	6.3	8	
Hyundai Courier Spectra (C486SLC/25)	3:30	01:01	57	01:13	68	0.1	1	01:57	60	6.7	46	7.4	19	
IBM ThinkPad 720C (IBM 486SLC/2)	3:30	04:03	21	01:01	41	1.5	51	01:21	54	7.4	15	8.9	65	
Jetta Jetbook 486DX/33 (486DX/33)	3:30	02:33	43	01:18	43	1.7	64	01:21	54	6.6	40	8.0	45	
Micro Electronics WinBook 486SLC/E/33 (C486SLC/E-33)	3:30	03:47	27	01:01	50	0.9	6	03:06	3	6.5	38	7.0	13	
Micro Express NP943 Notebook PC (486DX/33)	3:30	04:14	12	01:01	50	1.9	65	01:41	39	7.2	12	8.4	50	
Mitsuba Ninja 486SX/25 (486SX/25)	3:30	02:48	45	01:01	40	1.0	9	02:03	26	6.9	52	7.4	19	
NEC UltraLite Versa 25C (486SL/25)	3:30	03:32	9	02:00	44	1.1	14	01:49	34	6.9	52	8.6	62	
Packard Bell 486DX/25 Notebook (486DX/25)	3:30	01:01	39	02:39	27	1.4	44	01:51	31	6.1	6	8.0	45	
PC Brand Active Color LeaderBook Pro (486DX/33)	3:30	N/A	-	01:24	67	1.4	44	01:00	67	6.9	52	8.6	62	
Poly NB325V (386SL/25)	3:30	01:01	55	01:32	64	0.8	3	02:03	26	6.6	40	7.4	19	
Poly NB425C (C486SLC/25)	3:30	01:01	49	01:44	56	1.3	26	01:22	52	6.7	46	7.2	15	
Samsung NoteMaster 486SLC Model S3800 (C486SLC/25)	3:30	03:12	37	02:01	29	1.2	22	01:01	62	6.4	32	7.8	31	
Santron 486 Jetbook (486DX/33)	3:30	01:01	44	01:01	50	1.4	44	01:46	38	6.6	44	8.0	40	
Tenex 486SLC/25 Notebook (486SLC/25)	3:30	01:01	7	02:03	33	1.9	65	01:35	43	6.5	39	9.0	66	
Tenex 486DX/33 Chroma (486DX/33)	3:30	01:01	1	02:01	41	2.0	67	01:02	66	7.7	67	9.0	66	
TI TravelMate WinSLC 25 (TI 486SLC/25)	3:30	03:01		01:41	54	1.3	26	02:48	8	6.6	41	6.8	5	
TI TravelMate 4000 WinDX/25 (486DX/25)	3:30	01:01	16	01:01	50	1.3	26	01:22	52	6.5	38	6.9	6	
TI TravelMate 4000 WinDX2/40 Color (TI 486DX2/40)	3:30	01:01	19	02:15	37	1.3	26	01:14	57	6.7	46	7.5	23	
TI TravelMate 4000 WinDX2/50 (486DX2/50)	3:30	01:01	11	01:01	50	1.3	26	01:01	62	6.4	32	6.9	6	
TI TravelMate 4000 WinSX/25 (486SX/25)	3:30	01:01	4	04:18	2	1.3	26	03:17	6	6.0	11	6.9	6	
TI TravelMate 4000 WinSX/25 Color (486SX/25)	3:30	01:01	24	02:16	35	1.3	26	01:47	37	6.1	14	7.4	19	
Toshiba Satellite T1850C (386SX/25)	3:30	01:47	27	01:01	40	1.6	60	01:18	58	7.0	12	8.4	50	
Toshiba T4400C (486DX/25)	3:30	04:36	15	02:22	31	2.4	68	01:01	62	8.0	16	9.9	68	
Toshiba T4500 (486SX/20)	3:30	01:01	7	01:01	4	1.4	44	01:43	39	6.3	29	7.5	23	
Toshiba T4500C (486SX/20)	3:30	04:13	16	01:01	50	1.5	51	01:13	57	6.7	46	8.2	50	
Twinhead Slimnote 4DX/33T (486DX/33)	3:30	01:54	48	01:16	43	1.9	65	01:05	64	6.7	46	8.2	50	
Twinhead Slimnote 4DX2/66T (486DX2/66)	3:30	02:39	50	02:01	44	1.9	65	01:23	49	6.8	48	8.3	34	
Twinhead Slimnote 4SX/33M (486SX/33)	3:30	03:05	18	01:01	50	1.3	26	01:33	44	6.1	24	7.8	31	
ZDS Z Lite 320L (386SL/20)	3:30	04:02	23	01:01	8	0.9	6	03:14	7	4.3	3	5.1	3	
ZDS Z-Note 425Ln Model 120 (486SL/25)	3:30	03:33	2	04:23	1	1.2	22	01:01	62	4	5.8	19	7.3	17
ZDS Z-Note 425Lnc Model 200 (486SL/25)	3:30	04:17	18	02:39	27	1.3	26	01:07	64	6.6	40	8.1	47	
ZDS Z-Note 425Lnp Model 120 (486SL/25)	3:30	01:01	13	02:17	35	1.3	26	01:05	64	6.5	37	8.0	40	
ZDS Z-Sport 420S (487SX/20)	3:30	04:02	23	01:43	53	1.3	26	01:47	37	6.8	48	7.8	31	
ZDS Z-Sport 425S (487SX/25)	3:30	N/A	-	01:43	53	1.3	26	01:51	31	6.8	48	7.7	28	
Zeos Contenda (386SL/25)	3:30	01:01	41	01:01	24	1.0	9	02:40	12	4.1	4	5.1	2	

N/A: Not Available

* The 2-digit cycle used for testing is 3:30 minutes. ** The 2-digit cycle used for testing is 3:30 minutes.

** The 2-digit cycle used for testing is 3:30 minutes.

score to 2 hours 24 minutes.

The Ergo's trackball, placed in the center of its wrist rest, moves freely and lets you shift easily from typing to cursor movement. The built-in flat wrist rest can forestall hand pain despite long hours of

Ergo PowerBrick 486

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD

typing. The keyboard is arranged nicely, with an inverted-T cursor-key layout, and it has a responsive key-stroke feel.

The PowerBrick scored around the middle of its CPU

class in performance tests. The system's Cirrus Logic video chip set and Toshiba 9.5-inch-diagonal, monochrome LCD panel scored second on the Graphics Winmark test among 33-MHz 486DX systems, ninth overall, so a demanding Microsoft Windows user might factor that in. The screen was easy to read under all lighting conditions.

The wrist rest and trackball are the best features of the otherwise typical 486DX/33 PowerBrick.—Bruce Brown

Gateway 2000

Gateway Nomad 425SXL

Gateway Nomad 450DXL

Texas Instruments

TI TravelMate WinSLC 25

TI TravelMate 4000 WinSX/25

TI TravelMate 4000

WinSX/25 Color

TI TravelMate 4000 WinDX/25

TI TravelMate 4000

WinDX/25 Color

TI TravelMate 4000 WinDX/50

Talk about a street gang. Dressed in charcoal gray plastic instead of black leather, Texas Instruments' new road warriors



FACT FILE

Gateway Nomad 425SXL

Gateway Nomad 450DXL

Gateway 2000, 610 Gateway Drive N. Sioux City, SD 57049; 800-846-2000, 605-232-2000; fax, 605-232-2023

List price: 425SXL, \$1,995; 450DXL, \$2,995.

Tested configuration: 4MB 60-ns RAM, 128MB Seagate ST9144A IDE hard disk with a 64K buffer (425SXL), 208MB Seagate ST9235AG IDE hard disk with 64K buffer (450DXL), 1.44MB floppy disk drive, 9,600-bps data/fax modem (425SXL).

Options: 8MB RAM upgrade, \$200; 20MB RAM upgrade, \$1,700; extra battery, \$85; 9,600-bps data/fax modem, \$415; 2,400-/4,800-bps data/send-only fax modem, \$85; extra AC adapter, \$85; carrying case, \$50.

In short: The Gateway Nomad 425SXL and Nomad 450DXL compete well in this roundup with their combination of low price and excellent battery life. A special system chip set helps to prolong battery life and keep the units' heat levels low, something that other manufacturers have not been successful at. The Nomad 450DXL offers lots of raw processing power with its 486DX2/50 CPU, while the battery in the 486SX/25-based Nomad 425SXL logged a ZDigit Rundown test time of 6 hours 46 minutes, plenty of time for the average traveler.

ON READER SERVICE CARD

and their slightly tweaked Gateway 2000 blood brothers make a formidable band of portable PCs.

The entire gang shares numerous features: up to 20MB of system memory (except for the TI TravelMate WinSLC 25, which can only take 6MB of RAM), up to a 208MB hard disk drive, a nicely laid out keyboard with a disappointingly "mushy" feedback, and either a Microsoft BallPoint mouse (with a cordless QuickPort) or a Thumbelina-type serial mouse. Monochrome versions weigh about 5.6 pounds, while color versions

weigh about 6.2 pounds.

TI OEMs its system to Gateway 2000; the Nomads generally come with a larger software bundle to differentiate them.

GANG COLORS

The only two color-capable members of this group both hail from the TI camp: the \$4,199 TI TravelMate 4000 WinDX2/40 Color and the \$2,999 TI TravelMate WinSX/25 Color. Both have passive-matrix screens which provide passable color, but certainly nothing that compares with active matrix. However, TI has an active-matrix TFT version of the DX2/50 waiting in the wings. Unfortunately for Texas Instruments, you can find today some portables equipped with active-matrix screens for under \$3,500; so TI has to come up with something more in order to attract buyers.

These portable PCs also have processing power—all the way from the Cyrix 486SLC/25 to the Intel 486DX2/50. TI touts the accompaniment of its own system chip set with its clock-doubled units, which allows the CPU to fall to 0MHz in real time when not in use. Not only does this have the desired effect of controlling CPU heat levels, it also provides competitive power conservation. The TravelMate 4000 WinDX2/40 Color clocked in at 2 hours 15 minutes on PC Labs' Battery Rundown test and 4 hours 12 minutes on the ZDigit Rundown test

Gateway Nomad 425SXL	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	AVERAGE

Gateway Nomad 450DXL	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	AVERAGE

Dell calls their 325SLi's video a technical "oversight."



(unretouched photo)

You'll call your ZEOS® Contenda's video a technical marvel.

A technical "oversight of the past." That's what John Medica, vice president of portable products at Dell, called the non-backlit screen of their 325SLi notebook in a recent interview.*

We couldn't agree more.

That's why the ZEOS Contenda has a *backlit VGA screen* — one that displays 64 shades of gray at a resolution of 640 by 480. It measures 7.4 inches diagonally, with a dot pitch of .23mm.

Roughly translated, that means great video.

The June 1993 issue of *PC Sources* agrees.

"Aside from its diminutive packaging, the real eye-opener is the Contenda's screen. Brightness and contrast controls... provide an excellent range of adjustment that should make the viewing easy on the eyes under a variety of

lighting conditions. The display serves Windows well, too, with a minimum of ghosting and trailing as screen objects are moved about."

No technical oversights here.

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FACT FILE

TI TravelMate WinSLC 25

TI TravelMate 4000 WinSX/25

TI TravelMate 4000 WinDX/25

Texas Instruments, P.O. Box 202230,
Austin, TX 78720-2230; 800-527-3500,
817-771-5856; fax, 817-774-6660

List price: WinSLC 25, \$1,899; WinSX/25, \$2,199; WinDX/25, \$2,799.

Tested configuration: 2MB 70-ns RAM (WinSLC 25), 4MB 60-ns RAM (WinSX/25 and WinDX/25); 64MB Seagate ST9077A IDE hard disk with 32K buffer (WinSLC 25), 128MB Seagate ST9144A IDE hard disk with 64K buffer (WinSX/25 and WinDX/25); 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, TravelPoint.

Options: 2MB or 4MB RAM upgrade, \$279; 16MB RAM upgrade, \$1,999; expansion station with three 16-bit expansion slots and three 3.5-inch drive bays, \$929; extra nickel cadmium battery, \$89; 14,400-/9,600-bps data/fax modem, \$599; Ethernet module with 10BaseT and thick coax connectors, \$469; Token-Ring adapter 4/16, \$899; numeric keypad, \$59; battery charger, \$149; SCSI adapter, \$369; I/O adapter, \$199.

In short: These worthy and capable members of the Texas Instruments notebook family compete on much the same platforms as their many siblings from other makers: light weight, great battery life, and nice prices. But beware: Though the TravelMate WinSLC 25 has a great price tag, it's based on the company's own low-cost 486 clone processor and didn't keep up with other 486-class CPUs on PC Labs' performance tests.

ON READER SERVICE CARD

with power-saving features enabled.

The TI TravelMate WinSX/25 Color managed 2 hours 16 minutes on the Battery Rundown test and 3 hours 44 minutes on the ZDigit Rundown test. On PC Labs' benchmark tests, both machines did well for their processor class. The WinSX/25 came in third or fourth (compared with all other SX/25-MHz systems) on all tests except memory and Graphics Winmark where it placed second. The DX2/40 didn't have any other systems directly in its processor class, but compared with all the systems in this roundup it scored excellently, successfully reaching the upper echelon on all

TI TravelMate WinSLC 25

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**

VENDOR SERVICE & RELIABILITY

Reliability **AVERAGE**

Repair service **AVERAGE**

Technical support **AVERAGE**

tests save for video, where it ranked forty-fifth.

TRAVELMATE WINDX2/50 AND GATEWAY NOMAD 450DXL

These systems provide the muscle for the TI/Gateway gang. They are distinguished by monochrome screens and Intel DX2/50-MHz processors.

Oddly enough, though the two systems are identically configured, their battery test scores differed widely. The TI WinDX2/50 came in at about 3 hours on the Battery Rundown test, while the Gateway Nomad 450DXL managed 2 hours 16 minutes. The difference nearly disappeared on the ZDigit Rundown test with power management features activated, where the TI WinDX2/50 lasted 5 hours 21 minutes, while the Nomad 450DXL came in at 5 hours 32 minutes.

Scores for these portables on the PC Labs benchmark test suite weren't divergent at all, both systems scoring at the top of their processor class in every test. On both the processor and memory tests, these machines turned in the two best scores of all systems in this roundup, sur-

passing even the more powerful DX2/66-equipped portables we tested.

TI TRAVELMATE 4000 WINSX/25 AND GATEWAY NOMAD 425SXL

The \$2,199 monochrome TI TravelMate WinSX/25 and the \$1,995 Gateway Nomad 425SXL are again identical

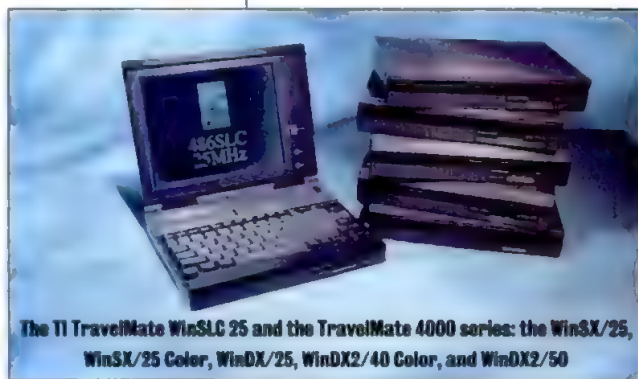
FACT FILE

TI TravelMate 4000 WinSX/25 Color

TI TravelMate 4000 WinDX2/40 Color

TI TravelMate 4000 WinDX2/50

Texas Instruments, P.O. Box 202230,
Austin, TX 78720-2230; 800-527-3500,
817-771-5856; fax, 817-774-6660



The TI TravelMate WinSLC 25 and the TravelMate 4000 series: the WinSX/25, WinSX/25 Color, WinDX/25, WinDX2/40 Color, and WinDX2/50

List price: WinSX/25 Color, \$2,999; WinDX2/40 Color, \$4,199; WinDX2/50, \$3,499.

Tested configuration: 4MB 80-ns RAM, 8MB 60-ns RAM, 128MB Seagate ST9144A IDE hard disk with 64K buffer (WinSX/25 Color), 208MB Seagate ST9235AG IDE hard disk with 64K buffer (WinDX2/40 Color and WinDX2/50); 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, Microsoft mouse.

Options: 2MB or 4MB RAM upgrade, \$279; 16MB RAM upgrade, \$1,999; expansion station, \$929; extra nickel cadmium battery, \$89; 14,400-/9,600-bps data/fax modem, \$599; Ethernet module with 10BaseT and thick coax connectors, \$469; Token-Ring adapter 4/16, \$899; numeric keypad, \$79; battery charger, \$149.

In short: Featuring light weight, great battery life, and very competitive performance, two of these Texas Instruments gangsters pack color. The third boasts a muscle-bound DX2/50 processor that managed fine performance scores with relatively little heat buildup.

ON READER SERVICE CARD

TI TravelMate 4000 WinSX/25

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **AVERAGE**

Repair service **AVERAGE**

Technical support **AVERAGE**



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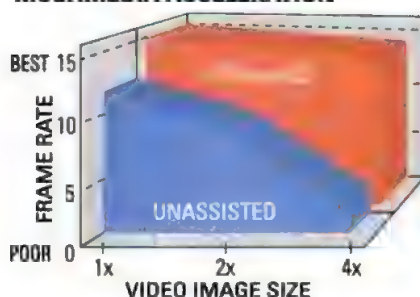
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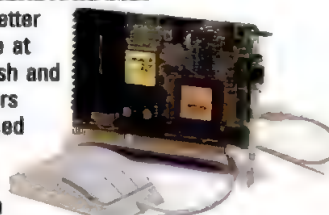
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machines with different labels.

Battery scores were excellent for both machines: the WinSX/25 came in at 4 hours 18 minutes on the Battery Rundown test and 7 hours 2 minutes on the ZDigit Rundown test, while the Nomad 425SXL clocked in at just under 3 hours on the Battery Rundown test and 6 hours 46 minutes on the ZDigit Rundown test. Benchmark test results for the WinSX/25 and the Nomad 425SXL were nearly identical, with both machines scoring high marks among other 486SX/25MHz systems and average scores when compared with all other notebooks in this roundup. Only the Nomad's video score fell slightly below the average, at forty-ninth place overall.

TI TravelMate 4000 WinDX/25	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

TI TRAVELMATE WINDX/25

This system represents the Intel 486DX/25-based product, but it is otherwise identical in all respects to the rest of the gang.

With a price of \$2,799, this system managed competitive battery times at 1 hour 47 minutes on the Battery Rundown test and 4 hours on the ZDigit Rundown test. Its PC Labs' benchmark test results, measured against all other laptops, were respectable as well, with video having the lowest score—thirtieth out of all systems in this roundup.

TI TRAVELMATE WINSXL 25

This last \$1,899 gang member is powered by TI's

version of the Cyrix 486SLC chip, and it is by far the lowest-priced system in the group. Of course, with a monochrome display, 6MB of RAM maximum, and a 60MB hard disk, a high price is uncalled for.

Battery times for the TravelMate WinSLC 25 were excellent: 3 hours 43 minutes on the Battery Rundown test and 4 hours 1 minute on the ZDigit Rundown test. The unit's benchmark test scores could only be compared against those of all the other laptops that we reviewed in this roundup (as opposed against those of a similar processor class), and these were consistently in the lowest quartile.—*Oliver Rist*

GRiD Systems Corp.

GRiD Convertible

As pen technology creeps toward maturity, the 386SL/25-based GRiD Convertible, from GRiD Systems Corp., offers the benefits of pen computing without putting you through keyboard withdrawal or sticker shock.

The Convertible, whose screen folds flat to cover the keyboard, comes with a Type II PCMCIA slot. The external floppy disk drive uses the parallel port, which means you can't print and read a floppy disk at the same time. The keyboard is comfortable and provides easy

TI TravelMate 4000 WinDX2/40 Color

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

TI TravelMate 4000 WinDX2/50

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE



FACT FILE

GRiD Convertible

GRiD Systems Corp., 7 Village Circle,
Westlake, TX 76262; 800-934-4743,
817-491-5200; fax, 817-491-5982

List price: \$4,790

Tested configuration: 8MB 80-ns RAM with 64K external cache, 123MB Toshiba MK-424FC IDE hard disk with 32K buffer, 14,400-/9600-bps data/fax modem, DOS 5.0, Microsoft Windows for Pen Computing, pen.

Options: 2MB RAM upgrade, \$225; 6MB RAM upgrade, \$595; extra nickel cadmium battery, \$99, extended battery, \$149; extra AC adapter, \$129; 12-volt battery adapter, \$129

In short: The Convertible turned in decent benchmark test results, but it disappointed in terms of battery life.

514 ON READER SERVICE CARD

access to a wide range of power-conservation features. The screen cannot be flipped over to close in the traditional manner but is covered with glass. The screen locks into a fixed position—no adjustments can be made for lighting.

The Convertible turned in scores on our processor, memory, and video test routines consistent with its CPU class, but its hard disk turned in some of the slowest times of any 386SL/25 we tested. Despite this, the Convertible outperformed its processor classmates on our Windows Applications tests. Battery life was just over 2 hours with power conservation on, 1 hour 37 minutes with those features off.

Overall, the unique Convertible offers users excellent technology at a reasonable price.
—*Stephen W. Plain*

GRiD Convertible

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR

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Floppy	One	One
MS-DOS, Windows 3.1 and mouse	Yes	Yes
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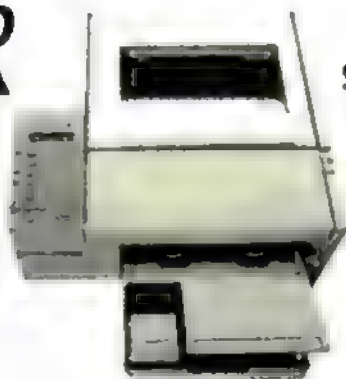
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HyperData Technology Corp.

HyperBook 2300DLC/40

HyperBook 2300DX2/50

The HyperBook 2300 series is the latest generation of notebook computers from HyperData Technology (formerly SunRace Technologies). While neither of the machines is the sleekest or most flexible, they both have solid features and displayed consistently excellent performance.

HyperBook 2300DLC/40	
SUITABILITY TO TASK	
Road warrior	FAIR
DOS applications	GOOD
Windows applications	GOOD
Desktop replacement	GOOD

The \$3,695 HyperBook 2300DLC/40 and the more powerful \$4,195 HyperBook 2300DX2/50 are both solidly built, and they weigh about 8.3 pounds each. This excessive weight is a result of including two large nickel cadmium batteries (which function as a unit) as well as a sizable AC adapter with each unit. For their bulk, however, the batteries performed well.

Both machines scored slightly below average on the Battery Rundown test, with the 2300DLC/40 coming in at 1 hour 47 minutes and the 2300DX2/50 coming in at 1 hour 43 minutes.

Both of the units' keyboards are of standard layout, which requires the use of a function key to access an embedded numeric keypad and the F11 and F12 keys.

Both of the screens looked fairly clear and sharp from most angles, but they did have troublesome ghosting. Both the contrast and the brightness ranges can be adjusted by using the sliding switches located in the upper right-hand corner of the keyboard.

In addition, each machine has an external VGA monitor port, a bidirectional parallel port, a dedicated scanner

HyperBook 2300DX2/50	
SUITABILITY TO TASK	
Road warrior	FAIR
DOS applications	EXCELLENT
Windows applications	GOOD
Desktop replacement	GOOD



FACT FILE

HyperBook 2300DLC/40

HyperBook 2300DX2/50

HyperData Technology Corp., 809 S. Lemon Ave., Walnut, CA 91789; 800-786-7223, 909-468-2955; fax, 909-468-2961

List price: HyperBook 2300DLC/40, \$3,695; HyperBook 2300DX2/50, \$4,195.

Tested configuration: 8MB 70-ns RAM with 128K external cache (2300DLC/40) or 256K external cache (2300DX2/50); 213MB Toshiba MK-2224FC IDE hard disk with 128K cache, 1.44MB floppy disk drive, 2,400/9,600-bps data/fax modem, DOS 5.0.

Options: 4MB RAM upgrade, \$300; 16MB RAM upgrade, \$1,000; 486DX2/66 CPU upgrade, \$200 (2300DX2/50); extra nickel cadmium battery, \$50; extra AC adapter, \$95; Logitech 3-in-1 mouse, \$35; PS/2 mouse, \$35.

In short: These fairly large notebooks from HyperData Technology (formerly SunRace Technologies) have quite a few attractive features and very respectable performance scores, but are not much to recommend because of their lack of flexibility and the promised improvements in the upcoming 3000 series. Nice touches, such as a bidirectional parallel port, a dedicated scanner port, and a SCSI port may make these units especially attractive to some users.



port, and the interesting addition of a SCSI port, making this a potential power system away from the office. Neither machine included a PCMCIA slot or a built-in pointing device.

Overall performance of the 2300DLC/40 and the 2300DX2/50 was strong in all areas except video. The 2300DLC/40—the only machine in this roundup with a Cyrix CX486DLC/40 chip—remained in the top ten on all test suites, save on the Graphics Winmark and DOS video routines, where it was only an average performer.

The 2300DX2/50 ran exceptionally well, landing in the top ten or better overall performers on all benchmark tests except the DOS video routines, where it ranked second in its processor class but 25th overall.

For the price, HyperData could have put more thought into design and presentation in order to complement the large disks and fast CPUs of these machines.—Adam A. Hicks

Hyundai Electronics America

Hyundai Courier

With a price of \$1,199, the monochrome Hyundai Courier is the least expensive notebook in this issue's roundup. But you get what you pay for: The Courier scored near the bottom on all of our perfor-



FACT FILE

Hyundai Courier

Hyundai Electronics America, 1955 Lundy Ave., San Jose, CA 95131; 800-933-3445, 408-473-9200; fax, 408-894-9751

List price: \$1,199.

Tested configuration: 4MB 70-ns RAM, 85MB Conner CP2088 IDE hard disk with 32K cache, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 120MB hard disk upgrade, \$461; 2MB RAM upgrade, \$149; 6MB RAM upgrade, \$449; extra battery pack, \$149; numeric keypad, \$65; 12-volt battery adapter, \$65.

In short: The Hyundai Courier is certainly inexpensive enough when compared to its competition, but, unfortunately, you get what you pay for—minimal features and marginal quality. While it does offer a useful PCMCIA slot, the unit's cramped and poorly configured keyboard, inconveniently located trackball, and low-quality monochrome display make it hard to recommend.



Hyundai Courier	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR

mance tests, and, with the exception of a PCMCIA slot, the unit contains few extras.

The Courier's keyboard is both cramped and poorly laid out, and the feel of its

keys is clackety and unsubstantial. The cursor keys are laid out in an inverted-T configuration, but they are embedded among other keys and they are also unusually narrow. The Courier's display quality quickly deteriorates at even a slight angle. In graphics mode, there is also some troublesome shadowing.

A trackball is built into the machine directly above the keyboard to the right—an inconvenient placement. The two mouse buttons that are used to control it are vertically aligned to the left of it. This layout is awkward, since you must reach across the keyboard with your left hand.

The Courier's nickel cadmium battery, while weighing less than a pound, was rather short on life span. On the Battery Rundown test, it clocked in at 1 hour 55 minutes; on the ZDigit Rundown test, it lasted 2 hours 2 minutes.

Despite its low price, this machine is hard to recommend because of its uncomfortable keyboard, low-quality display, and poor performance.—*Sheryl Canter*

Hyundai Electronics America Hyundai Courier Spectra

The Hyundai Courier Spectra, a passive-matrix color notebook based on the Cyrix CX486SLC/25 chip, provides basic functionality for the relatively low price of \$2,499. Hyundai also sells a monochrome notebook called the Hyundai Courier, but this is a completely dif-

Hyundai Courier Spectra	
SUITABILITY TO TASK	
Road warrior	FAIR
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR



FACT FILE

Hyundai Courier Spectra

Hyundai Electronics America, 1955 Lundy Ave., San Jose, CA 95131; 800-933-3445, 408-473-9200; fax, 408-894-9751

List price: \$2,499.

Tested configuration: 4MB 80-ns RAM, 120MB Areal 15-ns IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 2,400-bps/9,600-bps send/receive fax modem, DOS 5.0, Microsoft Windows 3.1, built-in trackball.

Options: 8MB RAM upgrade, \$499; 16MB RAM upgrade, \$1,999; extra battery, \$69; battery charger and AC adapter, \$139; 12-volt adapter, \$65.

In short: Aside from its tiny screen and poor battery life, the Hyundai Courier Spectra is a good choice as a budget color notebook. Its keyboard is well laid out and easy to use.

917 ON READER SERVICE CARD

ferent machine.

The first thing you will notice about the Courier Spectra is the small size of its system font. Even given the small screen size (8.5 inches diagonally), the font is smaller than it has to be. If you have trouble reading small type, this is not the notebook for you. The unit's poor screen contrast compounds the readability problem. In text mode, the background is silvery rather than black, and the characters are dull gray no matter how you adjust the contrast settings. The display is better in graphics mode, but the color is still a bit washed out.

This unit also ran into difficulty in battery testing. On the Battery Rundown test, the Courier Spectra came in dead last at 1 hour 23 minutes. Its ZDigit Rundown score of just under 2 hours was not much better, barely placing it above the bottom 10 percent.

On a positive note, the keyboard gives good resistance and has full-size keys that

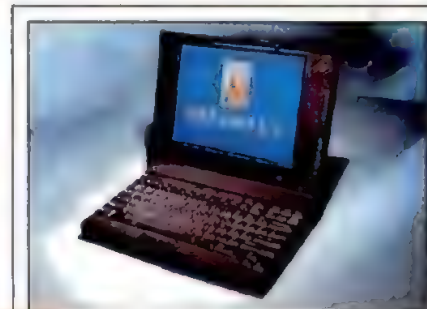
are well laid out, making the unit comfortable to use. A trackball is built into the lower-right-hand corner of the keyboard, with mouse buttons on the lower left. This arrangement is very easy to use.

Though it has few extras, the Courier Spectra is a very serviceable, low-priced color notebook. If you are not doing a lot of work in text mode, it is a good choice for a budget unit.—*Sheryl Canter*

IBM Personal Computer Co.

IBM ThinkPad 720C

IBM hit a home run with the ThinkPad 700C, and Big Blue has done it again with the IBM ThinkPad 720C. Since the system is priced at \$4,695, you may find a cheaper notebook, but you probably won't find a better one overall. The 8.9-pound (travel weight) 720C uses a faster



FACT FILE

IBM ThinkPad 720C

IBM Personal Computer Co.,
Rte. 100, Somers, NY 10589;
800-772-2227; fax, 800-426-4329

List price: \$4,695.

Tested configuration: 4MB 80-ns RAM, IBM 160MB Direct Bus Access hard disk with 128K buffer, 2.88MB floppy disk drive, DOS 5.0.

Options: 2MB RAM upgrade, \$245; 4MB RAM upgrade, \$475; 8MB RAM upgrade, \$945; 14,400-bps PCMCIA data/fax modem, \$595; expansion cartridge with AC adapter, \$445; quick charger, \$195; AC adapter, \$15; 12-volt adapter, \$185; keyboard/mouse connector, \$40; external numeric keypad, \$85.

In short: The IBM ThinkPad 720C is a superbly engineered active-matrix machine with all the features you could want in a notebook. Its weight and price may be hefty, but its solid keyboard and adequate battery life may make it worth saving up for.

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i imagine

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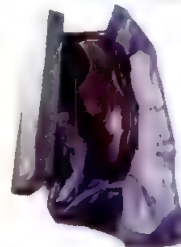
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"virtual" wind tunnels?



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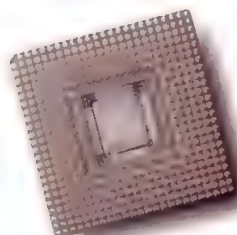
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So everyone who needs access to data gets it as it develops. In other words, ClientServer computing takes what has been a serial process into a parallel process. Saving months

months and years, plus

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i **magine the flexibility of
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Analysts say that by 1996, the Microsoft Windows NT operating system will represent more than 50% of all Windows products used on PCs, and Windows NT applications will represent 48% of the entire systems software market.

Microsoft

Our alliance with Microsoft brings you seamless hardware/software/operating system integration across all platforms

Surprising behavior for an industry that usually can't agree on the color of the sky. To make the most of the new operating system, Digital is supporting Windows NT across more platforms than any other manufacturer, from enterprise and workgroup-based AXP systems to low-cost Intel 486s.



Support across the broadest range of Intel and AXP platforms is part of what makes Digital the #1 supplier of Windows NT solutions worldwide

Windows NT gives you the reliable, scalable and secure performance you need for workgroup computing,

application development, computer-aided design, manufacturing and engineering, and production-class business applications. Of course, Windows NT is just



one of the operating systems

Digital supports on high-speed AXP platforms. Please turn to pages 8-9 for information about running OSF/1 and OpenVMS operating systems on the DECpc AXP 150.

Performance: Windows NT runs new-breed 32-bit applications. It also runs today's MS-DOS® and 16-bit Windows apps right out of the box.

Robustness: Memory protection insures that no one process can bring down another — or the entire operating system.

Capacity: Windows NT can access 4GB of RAM and multiple terabytes of disk storage, while applications can address 2GB of RAM.

Responsiveness: Pre-emptive

scheduling guarantee that higher-priority processes take precedence over lower-priority processes. An asynchronous input/output model allows you to switch from one application to another, even if an app is printing or hung.

Security: Designed to meet U.S. Government C-2 security standards, users cannot delete system files or critical data.

Built-in networking: Offering secure, peer networking capabilities, Windows NT systems can be servers or clients at any platform level.



The "Dream machine of the Windows NT world." (PC Week, February 1993). AXP systems are recognized as the platform of choice for the new operating system.

Distributed computing: Windows NT takes networking all the way to true distributed applications. With a Remote Procedure Call facility, Windows NT is able to communicate with DCE services on OpenVMS, UNIX and other systems.

digital



Opening Windows

Digital is still the underdog when it comes to having the most powerful operating systems. This means yet another battle to be fought at the top of the good ol' PC hierarchy. Microsoft's Windows NT is the current king, but Linux is a strong contender. And now, with the release of Windows 95, the competition is heating up. The new Windows 95 is a more user-friendly version of the operating system, and it's designed to be more compatible with other operating systems. It's also more powerful, with a built-in firewall and a more secure network. And, of course, it's more powerful than any other operating system out there. It's the new king of the PC world.

i **Imagine downsizing without
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It comes as no surprise in this age of reduction and cost-consciousness that applications are finding their way from the glass room data center to the desktop.

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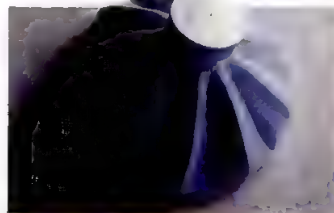
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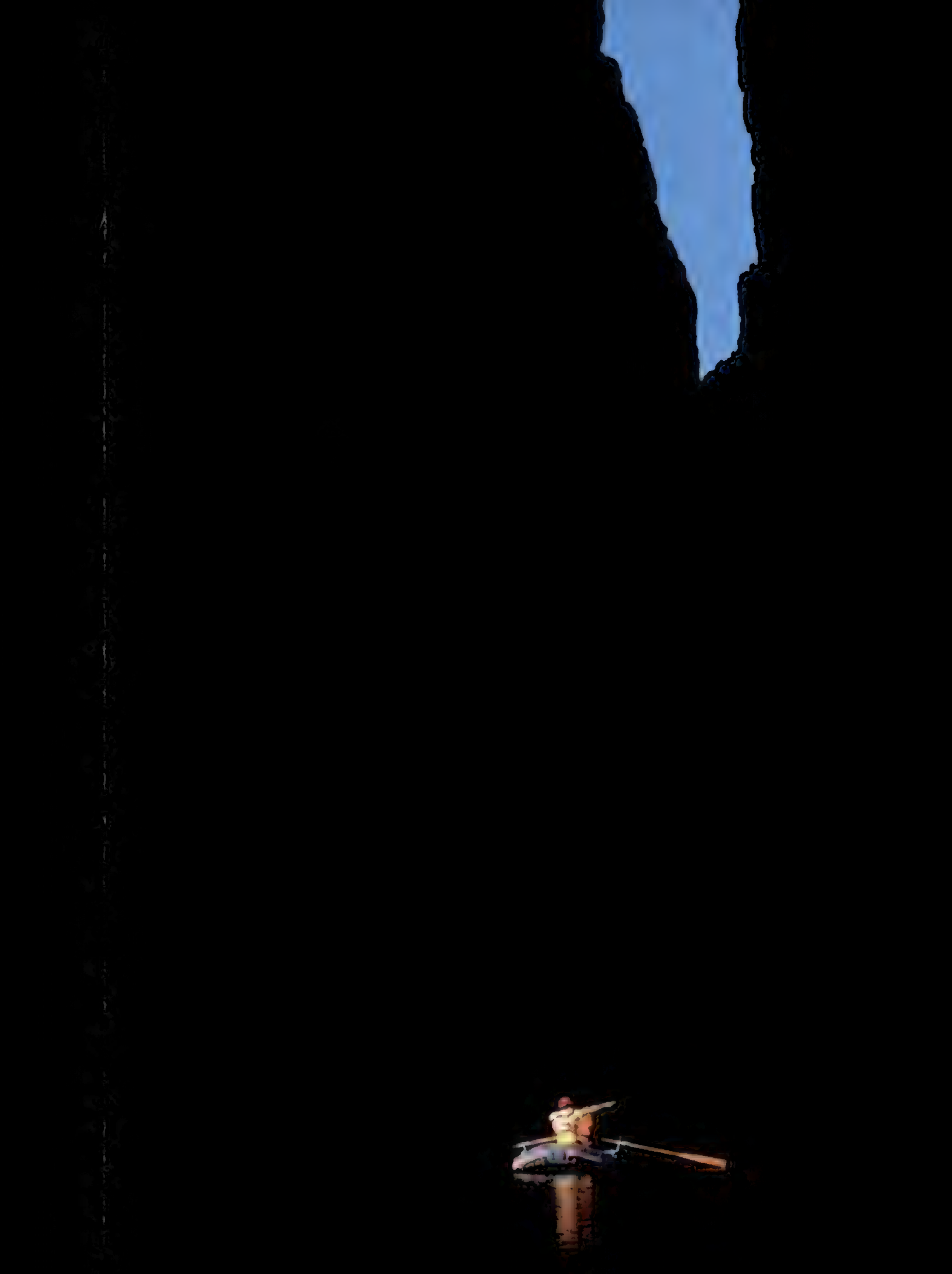


Move to Windows NT on AXP systems and get the benefits of downsizing without the headaches

your own pace. And though Windows NT on AXP systems handles the most sophisticated apps, it's quick to learn and easy to use for anybody who's used DOS or Windows™ 3.1.

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say they're stuck? Digital offers more services and support for Windows NT in more locations worldwide than anybody else. Take a look at the services listed here.

You'll see why exploring Windows NT, with Digital and Microsoft behind you, means you'll never have to search for help.

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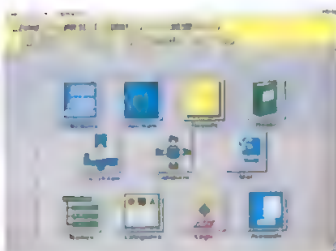
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PUTTING IMAGINATION TO WORK



■ Up Next

Highlights of ten new portables announced too late for review.

► CompuAdd 425TX

The CompuAdd 425TX is the first notebook to utilize PicoPower Technology's Evergreen power-conservation controller. The chip set combines PicoPower's Active Power Management and Heat Regulation technologies to extend battery life and reduce heat. 800-627-1967



▲ IBM ThinkPad 350 and ThinkPad 500

IBM enters the subnotebook market with the ThinkPad 500, based on IBM's clock-doubled 50-MHz 486SLC2. The 3.5-pound unit has a roomy keyboard, 7.5-inch screen, and one PCMCIA Type II slot. Expect the 500 to become available with a sealed lead acid battery that can be plugged directly into a wall socket for recharging. The 5.3-pound full-size ThinkPad 350 has one PCMCIA Type II slot and will also be available with a passive-matrix color screen. Built around Intel's 25-MHz 486SL, the 350 should be priced competitively with value-line portables.



◀ AcerNote 750C

Acer America Corp.'s 25-MHz 486SL-based AcerNote 750C is a full-size, 6.2-pound, active-matrix color notebook with two PCMCIA slots and a large, responsive built-in trackball. The keypad is removable, allowing for unobstructed access during upgrades. 800-733-2237



▲ HP OmniBook 300 and 100LX

Hewlett-Packard's HP OmniBook 300 successfully packs a full-size keyboard, built-in mouse, PCMCIA 2.0 Type III slot, and the ability to run on four AA batteries into a 2.9-pound unit that measures just 1.4 by 11.1 by 6.4 inches (HWD). The hand-held HP 100LX combines a functional keyboard with a PCMCIA 2.0 Type II slot and HP's infrared communications technology in a package that fits comfortably in your jacket's inside pocket. 800-443-1254

► TI TravelMate 4000 WinDX2/50 Color

The active-matrix color version of Texas Instruments' TI TravelMate 4000 WinDX2/50, which won our Editors Choice ("The Laptop Gap," March 30, 1993), combines powerful processing performance with a sharp, rich color display. 800-527-3500



▲ **GRiD Convertible** Similar to the AST PenExec 4/25 (right) in every respect, the next-generation GRiD Convertible also utilizes Intel's 3 3-volt, 25-MHz 486SL chip. Using Intel's chip set should significantly boost battery life and increase processing performance. 800-222-4743



▲ **AST PenExec 4/25** Designed around Intel's 25-MHz 486SL, the AST PenExec 4/25 combines pen-based tablet technology with the functionality and familiarity of a keyboard-driven notebook in a well-designed 5.75-pound unit with one PCMCIA Type II slot. 800-876-4278



▲ **Toshiba T4600C** The 6.9-pound Toshiba T4600C is one of the first notebooks to use Intel's new 33-MHz 486SL chip. The T4600C's 9.5-inch active-matrix color screen is 1 inch larger than the T4500's and the T4600C has two PCMCIA 2.0 Type III slots. 800-334-3445

chip (50 MHz) than the 700C, has a longer battery life, and adds a PCMCIA slot.

The 10.5-inch active-matrix thin-film transistor (TFT) color screen is, in a

IBM ThinkPad 720C	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

word, stunning. When the machine runs in text mode, the screen background is a dark, solid black, providing excellent contrast. When the machine runs in graphics mode, the colors are both sharp and even.

The ThinkPad 720C uses a unique pointing device called the TrackPoint II,

which looks like a pencil eraser. It is located between the G and H keys. Pressing on the TrackPoint II moves the mouse cursor around—heavier pressure increases cursor speed. The two mouse buttons are both conveniently located below the Spacebar.

The keyboard is also exceptional. The spring-loaded keys give satisfying resistance when typing. The cursor keys are arranged in an inverted-T layout and are positioned in the lower-right corner of the keyboard.

The IBM ThinkPad 720C is a superbly engineered machine that scored above the average on all our benchmark tests and turned in a solid 2-hour Battery Run-down test time. If you can afford it, this is the notebook to buy.—Sheryl Canter

Jetta International Inc.

Jetta Jetbook 486DX/33

Santron Computers Inc.

Santron 486 Jetbook

Jetta International manufactures three of the notebooks reviewed in this issue, two of which use the same basic case and CPU (Jetta's own \$2,345 Jetbook 486DX/33 and Santron Computers' \$2,120 486 Jetbook), and a third machine with a differ-



FACT FILE

Jetta Jetbook 486DX/33

Jetta International Inc., 51 Stouts Lane, #3,
Monmouth Junction, NJ 08852;
908-329-9651; fax, 908-329-0105

List price: \$2,345.

Tested configuration: 4MB 70-ns RAM with 8K external cache, 213MB Toshiba MK-2224 FCV IDE hard disk with 128K cache, 1.44MB floppy disk drive, 2,400/9,600-bps data/fax modem, DOS 5.0, Thumbelina trackball.

Options: 4MB upgrade, \$295; internal trackball, \$98; docking station, \$465; extra battery, \$135; internal 2,400-/9,600-bps data/fax modem, \$195.

In short: With no stand-out features, the Jetbook 486DX/33 is still a reasonable buy. It lacks the built-in trackball of the similar Santron 486 Jetbook, but makes up for it with better disk and video performance.

919 ON READER SERVICE CARD

ent, innovative design (the Micro Electronics WinBook 486, which is reviewed separately). The Jetbooks are competent machines with no particularly outstanding features or problems.

The Jetta and Santron notebooks both have a gray case with a 2-inch wrist-rest area in front of the keyboard, so your wrists don't have to hang in the air while you type. This ergonomic feature is a good idea, but both machines slope toward the front, making them less comfortable to use than the Micro Electronics WinBook and the Ergo PowerBrick, both of which sport relatively flat wrist-rest areas.

Both systems use a 64 gray-scale Hitachi 9.5-inch diagonal monochrome passive-matrix LCD screen, which, like most screens of this type, produces noticeable fading when viewed from the side. Also, the display does not fold back flat enough to fit under the front of an external monitor, a drawback if you intend to use an

external monitor often.

The Jetbook 486DX/33 justifies a higher cost than the Santron system by including a 213MB 12-ms Toshiba hard disk with its own 128K cache. This disk helped the Jetbook 486DX/33 attain significantly higher-than-average DOS and Winmark disk performance scores (which were also much better than the Santron's disk scores).

The Jetta also had a higher Graphics Winmark score than the Santron, even though both systems have the same Cirrus Logic video chip set, the same CPU, and 4MB of RAM.

The Santron 486 Jetbook comes with an added bonus: a small trackball has been placed just behind the keyboard and positioned slightly right of center, mak-

Jetta Jetbook 486DX/33	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD



FACT FILE

Santron 486 Jetbook

Santron Computers Inc., 1185 Chess Drive,
Suite I, Foster City, CA 94406; 800-938-7888;
fax, 415-571-6079

List price: \$2,120.

Tested configuration: 4MB 70-ns RAM, Toshiba 86MB 17-ms MK-2024FC IDE hard disk with 32K cache, DOS 5.0, Microsoft Windows 3.1, 2,400-/9,600-bps data/fax modem.

Options: 4MB RAM upgrade, \$225; 2,400-/9,600-bps data/fax modem, \$125.

In short: Almost identical to the competent but ordinary Jetta Jetbook 486DX/33, the Santron 486 Jetbook comes with a smaller hard disk but also with an integral trackball.

920 ON READER SERVICE CARD

ing it a little bit more comfortable to use than most for right-handed people.

The trackball positions the cursor fairly well, though you have to lift a hand to use it, but the buttons are flush with the case's surface and require more of a conscious effort to push than most. The Santron system comes with an 86MB 17-ms Toshiba hard disk with a 32K cache.

Santron 486 Jetbook	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR

The Santron and Jetta, both of which logged average Battery Rundown test times (2 hours 23 minutes and 2 hours 18 minutes, respectively) and below-average ZDigit Rundown test times (2

hours 50 minutes and 2 hours 33 minutes, respectively) are both relatively low-priced for 33-MHz 486DX notebooks, but otherwise have no truly compelling features.—Bruce Brown

Micro Electronics

Micro Electronics WinBook 486SLC/E/33

Scoring high in overall value and design, the \$1,799 Micro Electronics WinBook 486SLC/E/33 gives you a lot for your money, including an outstanding integral trackball. The only system in this review that is based on the 33-MHz Cyrix Cx486SLC/e microprocessor chip, the

Micro Electronics WinBook 486SLC/E/33	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD

WinBook unit balances an average overall performance rating with excellent battery life.

The WinBook's trackball sits in the middle of an expansive, flat wrist rest that is located in front of the keyboard.

This design makes it easy to use the trackball while you are typing. This machine scores high marks for ergonomics, design, and functionality.



FACT FILE

Micro Electronics
WinBook 486SLC/E/33
Micro Electronics, 1160 Steelwood Rd.,
Columbus, OH 43212; 800-468-2162; fax,
800-448-0308

List price: \$1,799.

Tested configuration: 4MB 70-ns RAM; 128MB Maxtor 2512B-A IDE hard disk with 32K buffer; 1.44MB floppy disk drive; 9,600-bps send/receive and fax/2,400-bps data modem; DOS 6.0; Microsoft Windows 3.1; trackball; PCMCIA, Version 2.0 slot.

Options: 8MB RAM upgrade, \$250; docking station, \$399; nickel hydride battery pack, \$79.95; math coprocessor, \$99; battery charger, \$19.95; 12-volt adapter, \$99.95.

In short: The WinBook 486SLC/E/33 has a screen that is ghostier than usual, and adjusting the contrast and brightness didn't completely resolve the problem. But in all other respects this Cyrix Cx486SLC/e-based notebook includes a plethora of features for its price.

ON READER SERVICE CARD

Value is also among the WinBook's greatest attractions. The standard system configuration includes 4MB of RAM and a 128MB hard disk, in addition to an internal data/fax modem.

On our battery tests, the WinBook performed exceptionally well, clocking in at 3 hours 28 minutes on the Battery Rundown test and 3 hours 47 minutes on the ZDigit Rundown test.

One shortcoming, however, of the WinBook is its 9.5-inch monochrome screen, which had the tendency to ghost images; adjusting the contrast and brightness controls never completely resolved the problem.

The Micro Electronics WinBook 486SLC/E/33 offers you a lot for your money, including possible relief for hands and wrists that are tired from typing.—Bruce Brown

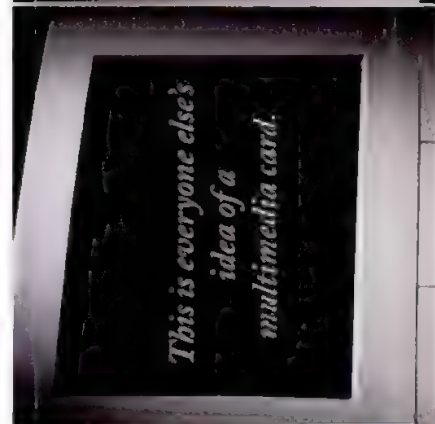
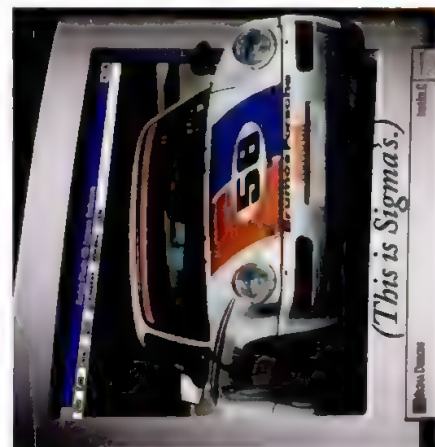
photorealistic color and 16-bit, CD-quality sound. Other so-called "multimedia" cards don't even offer video capability. ■ WinStorm also has interfaces for a standard IBM® joystick, full duplex MIDI, and a 20-voice stereo synthesizer. ■ And it's fully compatible with all popular sound standards, including Sound Blaster, AdLib, Pro AudioSpectrum 16, Thunder Board and MPC. ■ For more information on WinStorm, call: 1-800-845-8086, x253



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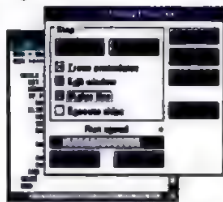
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Micro Express

Micro Express NP943 Notebook PC

Tenex Computer Express

Tenex 486DX/33 Chroma

The only place in which the two new notebooks from Micro Express and Tenex Computer Express have kept pace with the most recent advances in portable-PC technology is in their CPUs: Both systems are old designs with powerful 486DX/33 processors dropped into them.

Both of the machines come standard with 4MB of RAM and a 120MB hard disk drive, in addition to a 1.44MB 3.5-inch internal floppy disk drive. Each unit



FACT FILE

Micro Express NP943 Notebook PC

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price: \$1,899

Tested configuration: 4MB 70-ns RAM, 123MB Toshiba 3224 IDE hard disk with 64K buffer, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, serial mouse

Options: 4MB RAM upgrade, \$200; portable trackball, \$99, 2,400-/9,600-bps data/fax modem, \$169; extra nickel cadmium battery, \$65; Ethernet adapter, \$199

In short: The Micro Express NP943 Notebook PC offers an adequate 486DX/33 CPU, but lacks a pointing device. Although this machine has few features to recommend it, its battery life, at 3 hours 27 minutes on PC Lab's Battery Rundown test and 4 hours 18 minutes on the ZDigit Rundown test, was the longest among 486DX-based notebooks in this review

ON READER SERVICE CARD



FACT FILE

Tenex 486DX/33 Chroma

Tenex Computer Express, 56800 Magnetic Dr., Mishawaka, IN 46545; 800-776-6781, 219-272-1234; fax, 219-259-0300

List price: \$3,100.

Tested configuration: 4MB 70-ns RAM, 213MB Toshiba MK2224FC IDE hard disk with 128K cache, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, Logitech trackball, Bitcom, Bitfax.

Options: 4MB RAM upgrade, \$199; 8MB RAM upgrade, \$399; extra nickel cadmium battery, \$69.99; Ethernet module, \$249.99; SCSI interface, \$99.99.

In short: The Tenex 486DX/33 notebook, with a hazy passive-matrix color display that produces distracting ghosting, fell short in both battery life and video performance. The unit lacks a pointing device but sports a generously sized keyboard and produced top-rank scores on PC Labs' DOS and Microsoft Windows Applications tests.

ON READER SERVICE CARD

has one serial port and one parallel port, as well as ports for an additional keyboard, a VGA monitor, and an external floppy disk drive. RAM is upgradable to 16MB for either unit. The Tenex 486DX/33 Chroma is available with a 213MB hard disk, while Micro Express's NP943 Notebook PC is available with a 200MB

hard disk. Among the eight 486DX/33 machines that we reviewed, the NP943 had the longest battery life by far. Micro Express's unit clocked in at 3 hours 27 minutes on our Battery Rundown test

Micro Express NP943 Notebook PC

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR

WinMovie provides real-time video capture and playback with realistic, continuous movement ideal for presentations, training and entertainment. It even comes bundled with Microsoft® Video for Windows™, a \$200 value, so you can start the action as soon as you get your hands on it. ■ So call for WinMovie today. It's a scream! Sigma Designs, Inc., 47900 Bayside Parkway, Fremont, CA 94538, U.S.A. Phone: 510-770-0100 Fax: 510-770-2640 1-800-845-8086, x281

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■ Beyond Benchmark Tests

Some Delightful and Some Dubious Portable Features and Products

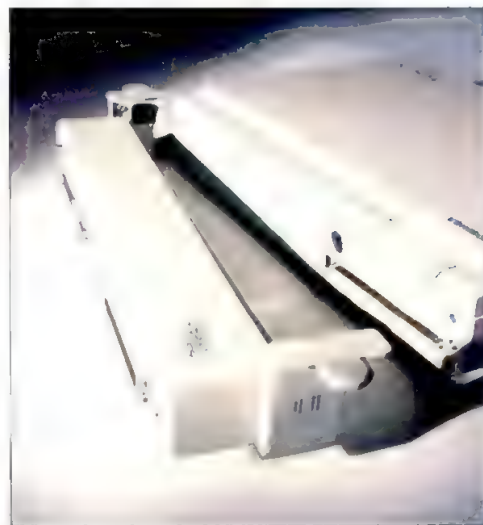
Here's a quick showing of a few things we liked and didn't like about the laptops reviewed in this issue. In addition to our usual comparison of portable features, this time we also ran across some third-party add-on products that were too good to pass up. If these products are any indication at all, the truly portable office is already here.

► **AC Adapter Brick** AC adapters have been accepted as bulky add-ons since the dawn of the portable age. But since Toshiba came out with its tiny two-prong adapter last year (left), power bricks the size of the one shipped with the NEC UltraLite Versa 25G really have no excuse.



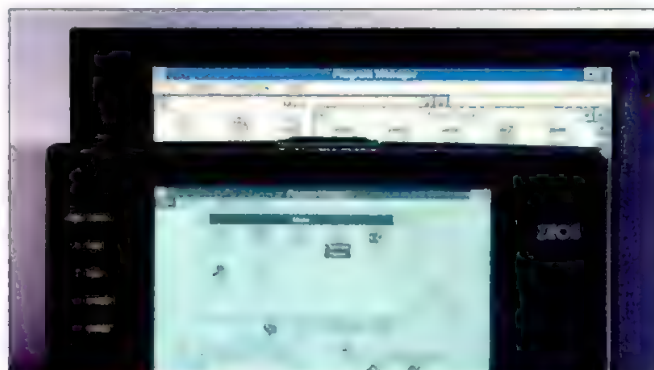
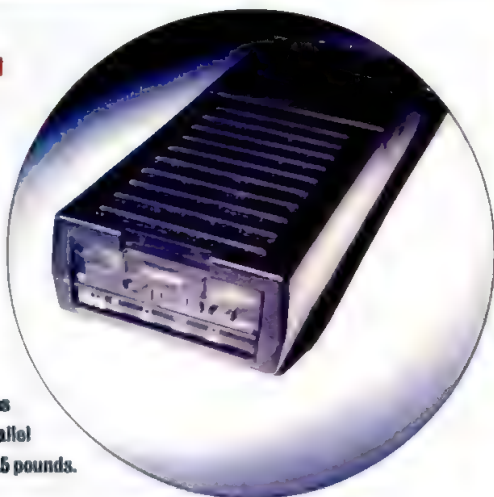
◀ **Overall Weight** The bigger your notebook, the more difficult a time you'll have packing; the heavier the notebook, the more you'll sweat jogging through airports. Any of the Texas Instruments' TravelMate 4000 series notebooks weigh 6.2 pounds, while the Tenex 486DX/33 Chroma comes in at an arm-straining 9.1 pounds.

► **Axonix CableMate** Axonix defines its \$199 CableMate as a "docking bar" for users to connect many peripherals in one step. The CableMate attaches to the expansion port of your Compaq LTE or Toshiba notebook. 800-886-9797.



► External Hard Disk

Another of the neat third-party peripherals we saw this time around was the SyDOS Pro[®] Note external hard disk. With a 42MB capacity, the unit configures through your parallel port and weighs 1.5 pounds. 800-437-9367.

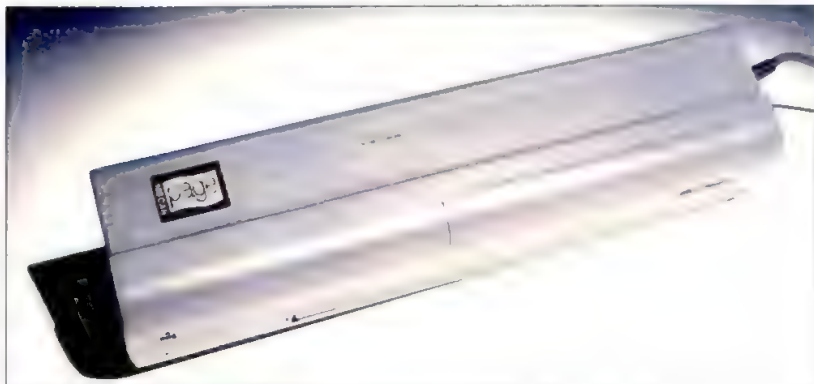


▲ **Screen Width** If a wide, readable screen is important to you, whether in color or monochrome, check out something like the IBM ThinkPad 720C's 10.4-inch display and try to avoid smaller screens like Zee's Contenda's 7.5-inch screen.



▲ **Internal Trackball** Two more heroes quested for the perfect-internal-trackball grail this roundup. IBM has come very close with its keyboard-situated TrackPoint II, while CompuAdd Express provides the usual slippery rodent with side-mounted buttons—but on the left-hand side of the system's case. It's not a critical weakness, but it's surely an annoyance to any right-handed users.

▼ **Portable Scanner** Nisca's Niscan Portable Grayscale Scanner is the first portable full-page scanner we've seen. Capable of 400 dpi with 256 shades of gray, the Niscan is almost fully Twain-compatible and is about the size of a carton of cigarettes. 800-245-7226.

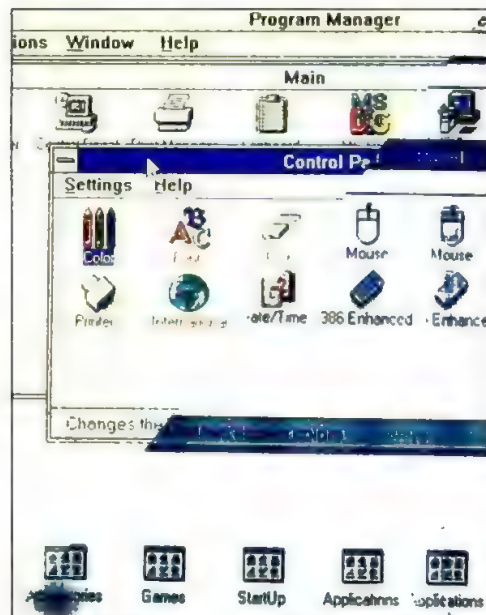


◀ **TI Battery Charger** Tired of juggling your productivity with your portable battery life? Texas Instruments' battery charger/discharger allows you to work with one battery while charging up a new one. It even allows a full discharge to condition your battery and avoid problems like battery "memory." At only \$149, it's certainly cheaper in the long run to invest in the charger than it is to keep buying expensive nickel cadmium batteries every time one dies on you.



◀ **Proxim RangeLAN** Proxim Corp.'s \$595 RangeLAN/PCMCIA is another add-on winner. A wireless LAN for notebook computers with a Type II PCMCIA slot, this system can access networks 300 to 500 feet away indoors. 415-980 1630.

► **Screens** You may pay less for passive-matrix color than for active-matrix, but that's no reason to stop comparison shopping there. Beware of differences among passive screens, like the beautiful dual-scan passive-matrix Compaq Contura screen (left) and the problematic AST PowerExec EL (the same screen found on the DECpc 325SLC). Though the Compaq uses a more advanced technology than the AST, its price is comparable.



and 4 hours 18 minutes on the ZDigit Rundown test with its power-management feature enabled; the Tenex's times were 2 hours 2 minutes on the Battery Rundown test and 2 hours 47 minutes on the ZDigit Rundown test.

Tenex 486DX/33 Chroma	
SUITABILITY TO TASK	
Road warrior	FAIR
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD

After removing one of the two batteries on these machines, users can add optional modules, including fax modems and Ethernet adapters. With just one battery available, however, the user

may have to rely on AC power to take advantage of such components.

A speedy 128K cache on the Chroma's 213MB Toshiba hard disk allowed this system to deliver top-rank performance on both our DOS and Microsoft Windows Applications tests. Both units, however, also ranked among the worst in DOS video performance.

The Tenex system differs from Micro Express' notebook in that it offers a passive-matrix color display. Both screens, however, have ghosting problems that can be very distracting to the user, and Tenex's Sharp screen often appears hazy because of its uneven backlighting.

While each of these machines sports a generously sized keyboard that includes all of the standard cursor and function keys, both lack built-in pointing devices, a factor that may be a serious drawback for those who use Microsoft Windows extensively.—Brad Stilwell

Mitsuba Corp.

Mitsuba Ninja 486SX/25

Performance scores for the Mitsuba Ninja 486SX/25 were erratic, almost reaching both extremes among units in its processor class, which includes such systems as the Gateway Nomad 425SXL. But the Ninja's compactness, exceptional display, and comfortable keyboard layout elevate it above the average laptop. And at a price of \$1,895, the bone-colored Mitsuba Ninja is easy on the budget.

The Ninja garnered below-average



FACT FILE

Mitsuba Ninja 486SX/25

Mitsuba Corp., 1925 Wright Ave., LaVerne, CA 91750; 800-648-7822, 909-392-2000; fax, 909-392-2021

List price: \$1,895.

Tested configuration: 4MB 70-ns RAM, 123MB Toshiba MK-2124FC IDE hard disk with 32K cache, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, mouse.

Options: 210MB hard disk upgrade, \$280; 4MB RAM upgrade, \$200; extra nickel hydride battery, \$110; 2,400-/9,600-bps data/fax modem, \$180; Ethernet adapter, \$150; 12-volt battery adapter, \$79; external keyboard, \$36; external numeric keypad, \$45.

In short: Thin and light, the Mitsuba Ninja 486SX/25 comes with a high-quality screen and mixed performance results. The unit had the lowest processor, memory, and DOS and Windows disk test scores for its CPU group, and its battery times on the ZDigit and Battery Rundown tests were below average.

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scores in its group on our Windows Applications tests and processor tests, and turned in mediocre times for ZDigit (2 hours 48 minutes) and Battery Rundown (2 hours 4 minutes). System memory is upgradable to 8MB or 20MB. The Ninja's memory module slots are located beneath a removable cover on the bottom of the unit, but can only be upgraded by the company.

This portable arrived with 4MB of RAM and a 120MB hard disk.

Though it has an 8-pound travel weight, its 2-inch thickness makes it easier to handle than many systems that are

lighter. Its monochrome 9.5-inch (diagonal) Sharp display is generous in size and clarity.

The keyboard has only 70 keys, but travel and distance between them can accommodate any user. Although it's small, the Ninja's keyboard features large Enter, Shift, and Backspace keys. However, it lacks a built-in trackball.

The Ninja carries a one-year warranty.—Camille N. Cline

NEC Technologies Inc.

NEC UltraLite Versa 25C

The 486SL-based NEC UltraLite Versa 25C is a state-of-the-art machine, complete with local-bus video. Its active-matrix color screen is clear and vibrant, and the unit is upgradable. Its hard disk is removable, its floppy disk drive can be removed to make room for a second battery, and it has two Type II PCMCIA slots. It does come with a \$4,269 price tag,



FACT FILE

NEC UltraLite Versa 25C

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-388-8888, 508-264-8000; fax, 800-327-8329

List price: \$4,269

Tested configuration: 4MB 80-ns RAM, 120MB Seagate ST9144A IDE hard disk with a 64K buffer, 1.44MB floppy disk drive, DOS 6.0, Microsoft Windows 3.1, Microsoft trackball

Options: 180MB hard disk, \$1,099; 4MB RAM upgrade, \$349; 8MB RAM upgrade, \$699; docking station, \$699; extra nickel hydride battery, \$199; 14,400-bps data/fax PCMCIA modem, \$699; extra AC adapter, \$99.

In short: Designed with upgradability in mind, and utilizing the latest technology, the NEC UltraLite Versa 25C can really grow with you.

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however. And the unit lacks a built-in pointing device; it uses a clip-on one.

Upgradability is the key to this machine; CPU, memory, hard disk, and screen are all upgradable. The CPU upgrade is the only upgrade that needs to be made at the factory.

The screen folds back 180 degrees and offers simultaneous external display. The unit's local-bus video system scored very well on our DOS and Microsoft Windows video tests, placing it third under DOS and second under Windows.

For an active-matrix color notebook, it also has good battery life; it turned in a Battery Run-down test score

of 2 hours and a ZDigit score (with power-conservation features enabled) of 3 hours 32 minutes. The Versa offers a variety of power-management features, ranging from LCD timeouts to a suspend mode that uses about 4 percent of the power that normal mode uses. An LED panel lets you know how much power management is being used and displays the amount of power left in the battery (or batteries).

NEC offers a 3-year warranty with the UltraLite Versa.

—Anush Yeghazarian

Packard Bell Electronics Inc.

Packard Bell 486DX/25 Notebook

Even though this season's machine from Packard Bell Electronics did not fare well in benchmark tests against the other 486DX/25 system in this roundup—the TI TravelMate WinDX/25—it performed more than adequately against the rest of the systems reviewed. Its several preinstalled Lotus applications and reasonable battery scores also propel it above the similarly designed Mitsuba Ninja 486SX/25, making this \$1,999 monochrome



FACT FILE

Packard Bell 486DX/25 Notebook

Packard Bell Electronics Inc., 9425 Canoga Ave., Chatsworth, CA 91311; 818-886-9988

List price: \$1,999

Tested configuration: 4MB 70-ns RAM, 123MB Toshiba MK2124FC IDE hard disk with 32K cache, 1 44MB floppy disk drive, 2,400-/9,600-bps data/send-only fax modem, DOS 5.0, Microsoft Windows 3.1, Lotus 1-2-3, Lotus SmartPics, Lotus Write, mouse

Options: None.

In short: Providing a combination of excellent battery time and adequate performance, the Packard Bell 486DX/25 Notebook is a serviceable portable. While it does lack a built-in trackball, the positioning of the floppy disk drive near the rear of the unit allows ample room for a portable trackball to be attached on either side



ON READER SERVICE CARD

notebook the slightly more attractive of the two.

Unlike many of the other units herein, however, the machine does not have a built-in trackball. However, the internal floppy disk drive is located toward the back of the machine, so there is space to attach a portable trackball. The system's 80-key keyboard features an inverted-T cursor pad (not separate from the Home, End, PgUp, and PgDn keys). The machine has an 8-

pound travel weight.

The Packard Bell 486DX/25 is bone-colored with darker beige keys, a color combination that achieves a less utilitarian look than that of many black and matte gray units. Although you might have some difficulty detecting where the SIMMs are enclosed, you can upgrade the unit's standard 4MB to 8MB or 20MB. And the proprietary screen lies flat for easier use with an external monitor on an office desktop.

Packard Bell offers a one-year limited warranty, a 24-hour toll-free technical support line, a BBS, and a messaging service.—Camille N. Cline

PC Brand Inc.

PC Brand Active Color LeaderBook Pro

Powered by a 486DX/33 processor, the \$3,994 PC Brand Active Color LeaderBook Pro turned in disappointing to mediocre performance scores overall. The LeaderBook is a midpriced active-matrix color system that comes with 4MB of RAM and hard disk configurations of 80MB, 120MB, and 200MB.

The active-matrix screen is this laptop's best feature. It is clear and easy to view from an angle. Another good feature is the trackball, which is placed below the keyboard and

is comfortable to use. The 84-key keyboard, however, feels cramped.

The system can be powered-down through an easy-to-use suspend mode. Automatic power-down can be set for 5, 10, or 15 minutes for the screen and from 0 to 15 minutes for the hard disk and system. However, on our Battery Run-down test, the PC Brand machine's display did not go off and thus the unit logged a short 1 hour and 24 minutes.

The system's stand-out benchmark test scores were its Graphics Winmark score—which was nearly the best—and

PC Brand Active Color LeaderBook Pro

SUITABILITY TO TASK

Road warrior	FAIR
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD

Packard Bell 486DX/25 Notebook

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR

VENDOR SERVICE & RELIABILITY

Reliability	AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE



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486DX	✓		
486SL	✓	✓	✓



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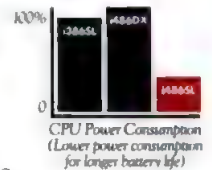


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FEATURES	COMPU DYNE Subnote	DELL 330SU	ZIGOS Contender	ZIGOS Z-120	GATEWAY Harlequin
CPU	486SL	486SL	486SL	486SL	C&T286
Weight (lbs)	3.6	3.5	4	10	13.5
Removable Hard Drive	Yes	No	No	No	No
RAM (standard/and maximum)	4/20	4/16	4/16	2/4	1/2
PCMCIA Type II Slot	Yes	Yes	No	Yes	No
Backlit VGA Display	Yes	No	Yes	Yes	No (CGA)
Battery Life	4	3	3	3.5	4
Integrated Trackball	Yes	No	Yes	No	No
Full size, Full Travel Keyboard	Yes	Yes	No	Yes	No
DOS/Windows	Yes	No	Yes	No	No
Price	\$1999	\$1799	\$1295	\$1899	\$1295

- Internal expansion compartment for optional memory upgrades or FAX/data modem saves the PCMCIA slot for other uses.
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- Full-size, full-travel 79 key keyboard with inverted-T cursor control, editing and function keys, a numeric keypad, and a large 16mm trackball with easy-to-use side panel buttons.
- PS/2™ port for an external PS/2 keyboard, mouse or numeric keypad.
- Optional 2400 bps data modem with 9600 bps send/receive FAX.
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- Only 5.8 pounds in an 8.5"x11"x1.6" package.
- Full-size 84 key keyboard with 36 function keys, including dedicated 'Page Up/Down', 'Home' and 'End' keys, for moving around a spreadsheet with military precision.
- 2.5 hour Nickel metal hydride battery.
- Integrated trackball.
- Internal 3.5", 1.44 MB floppy drive.
- Expansion station connector.
- Combination external keyboard-PS/2 mouse connector.
- Parallel port (doubles as a port for an external 5 1/4" floppy drive).
- 2 Serial ports (2nd serial port inside unit).
- External video support to 1024 x 768.
- Preloaded with Microsoft DOS 6.0 and Windows 3.1.

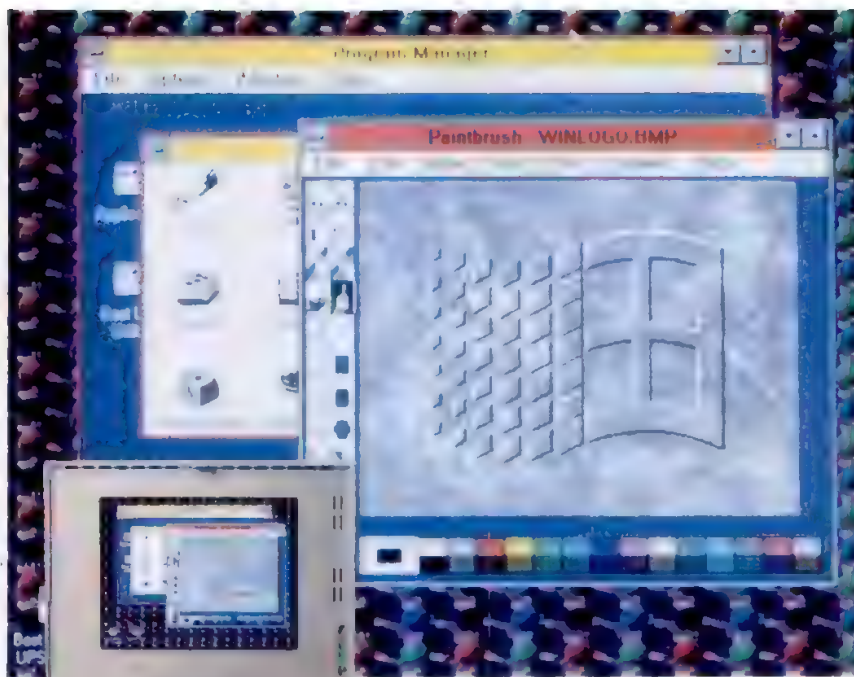


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SUB NOTEBOOK		
486SL/25	80 MB HD 4 MB RAM	\$1,999 <i>\$74/mo.</i>

MONOCHROME NOTEBOOKS		
486DX/33	210 MB HD 4 MB RAM	\$2,499 <i>\$92/mo.</i>

486DX2/66	210 MB HD 4 MB RAM	\$2,999 <i>\$111/mo.</i>
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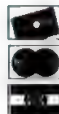
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PCMCIA: *Almost Here*

by Oliver Rist

The year 1992 was supposed to be the year PCMCIA card technology hit the big time. Now it's the middle of 1993 and we're still waiting. We set a late-May deadline for receiving shipping PCMCIA products, which netted us just 24 products; five more barely missed the cutoff date. The majority of devices we saw were modems, Ethernet network adapters, and dynamic RAM (DRAM) or flash memory cards. We also received three mini-hard disks, a marvelous PCMCIA-based radio LAN, and a SCSI adapter. After plugging these into the PCMCIA-capable notebooks reviewed in this roundup (including the Toshiba T4500 and T4500C, the Dell 325SLi, the CompuDyne 4SL/25Subnote, the AST PowerExec series, the DECpc series, the GRiD Convertible, the Hyundai Courier, the IBM ThinkPad 720C, the Micro Electronics WinBook 486SLC/E/33, the NEC UltraLite Versa 25C, and the ZDS Z-Lite 320L), we were still disappointed.

Plug-and-play is PCMCIA's most ambitious goal and its biggest shortcoming. Though you can purchase any of the cards listed here, you must still make do with interim drivers for your specific system. We found memory cards slightly easier to configure than modems or Ethernet cards, which had about the same level of difficulty. During our examination period, Award Software finished its universal PCMCIA BIOS module. This one-size-fits-all program reduced the configuration time significantly. Once vendors implement this new BIOS or similar products from Phoenix and SystemSoft, hardware plug-and-play compatibility will be achieved.

The advent of the SunDisk-type flash memory card has been touted as the death of hard disks, but flash products remain very expensive. Those we saw were faster than the mini-hard disk entries and the PCMCIA/ATA stan-

PCMCIA PRODUCTS AND FEATURES

MODEMS

	Phone number	Slot size	PCMCIA version
AMT StarCard 2442fx	714-375-0306	Type II	Release 2.0
AT&T KeepInTouch Card	813-530-2000	Type II	Release 2.0
Digital Equipment Corp. 9,600-bps Fax, 2,400-bps Data Modem	800-722-9322	Type II	Release 2.0
Megahertz PCMCIA Notebook Data/Fax Modem	800-527-8677	Type II	Release 2.01
Megahertz PCMCIA Notebook Data/Fax Modem with Xjack	800-527-8677	Type II	Release 2.01

MEMORY

	Phone number	Slot size	PCMCIA version
AMD AmC001AFLKA	800-222-9323	Type I	Release 2.01
AMD AmC002AFLKA	800-222-9323	Type I	Release 2.01
AMD AmC004AFLKA	800-222-9323	Type I	Release 2.01
Simple Technology Compaq Lite 4/25 Series Memory Card	800-367-7330	Type I	Release 2.01
Simple Technology IBM ThinkPad Memory Card	800-367-7330	Type I	Release 2.01
Simple Technology SRAM Card	800-367-7330	Type I	Release 2.01
Simple Technology Toshiba T4500 Memory Card	800-367-7330	Type I	Release 2.01
SunDisk Solid State Mass Storage System for HP Palmtop 100LX	408-562-0500	Type II	Release 2.01

NETWORK ADAPTERS

	Phone number	Slot size	PCMCIA version
D-Link DE-650C	800-326-1688	Type II	Release 2.0
D-Link DE-650T	800-326-1688	Type II	Release 2.0
Socket Communications EA	510-670-0300	Type II	Release 2.0
Socket Communications EA+	510-670-0300	Type II	Release 2.0
Xircom CreditCard Ethernet Adapter CE-10BC	800-874-7875	Type I	Release 2.0

OTHER

	Phone number	Slot size	PCMCIA version
Integral Peripherals PocketFile 42	303-449-8009	Type III	Release 2.01
Integral Peripherals PocketFile 85	303-449-8009	Special*	Release 2.01
New Media Visual Media SCSI Card	714-453-0100	Type I	Release 2.0
Proxim RangeLAN/PCMCIA	415-960-1630	Type II	Release 2.0
Western Digital Caviar UltraLite	714-932-4900	Type III	Release 2.01

* This product fits in a nonstandard slot on Toshiba T1900-, T4500-, and T4600-series portables.

dard makes them as easy to use as "D:." But at about \$400 for 4MB of flash storage, hard disks will stick around for quite some time.

Some of the most exciting news was from products we did not receive. We missed three static RAM (SRAM) memory cards from Epson America: the

512K (\$169.99), the 1MB (\$249), and the 4MB (\$389). Socket Communications managed to deliver two network adapters, but narrowly missed entering not only a \$325 serial port adapter card but also a Global Positioning System. Socket sees a market for the \$795 Socket Mobile GPS card, which was

COVER STORY

Portable PCs

Data speed/ fax speed (bps)	Price	Supply voltage
2,400/9,600	\$299	5 volts
14,400/14,400	\$599	12 volts
2,400/9,600	\$300	5 volts
14,400/14,400	\$599	5 volts
2,400/9,600	\$379	5 volts

Capacity	Price	Supply voltage
1MB	\$175	12 volts
2MB	\$270	12 volts
4MB	\$477	12 volts
8MB	\$750	5 volts
4MB	\$212	5 volts
1MB	\$165	5 volts
8MB	\$408	5 volts
10MB	\$879	12 volts

LAN type	Price	Supply voltage
10Base2 Ethernet	\$375	12 volts
10BaseT Ethernet	\$375	12 volts
10BaseT Ethernet	\$399	5 volts
10Base2 or 10BaseT Ethernet	\$420	5 volts
10Base2 or 10BaseT Ethernet	\$399	5 volts

Type	Price	Supply voltage
42MB hard disk	\$495	5 volts
85MB hard disk	\$695	5 volts
SCSI adapter	\$299	5 volts
Peer-to-peer radio LAN	\$595	5 volts
42MB hard disk	\$325	5 volts

adapted from the military for civilian use: accessing a \$12 billion U.S. Department of Defense satellite system for all-weather position and velocity information and even using the government's ultra-precise atomic clocks. Look for it and other interesting variations at Fall Comdex.



FACT FILE

PC Brand Active Color LeaderBook Pro

PC Brand Inc., 405 Science Dr., Moorpark, CA 93021; 800-722-7263, 805-378-7848; fax, 805-378-7801

List price: \$3,994.

Tested configuration: 4MB 70-ns RAM, 121MB Conner CP-2124 IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, built-in trackball.

Options: 200MB hard disk upgrade, \$400; 4MB RAM upgrade, \$300; 16MB RAM upgrade, \$1,500; extra nickel cadmium battery, \$69; 2,400-/9,600-bps data/fax modem with BitFax software, \$199; battery charger, \$89; extra AC adapter, \$89; 12-volt battery adapter, \$99.

In short: The PC Brand unit offers quality features and a good service policy but an ultimately disappointing performance.



ON READER SERVICE CARD

its DOS video score. If PC Brand had given the same attention to detail for the processor and memory design as it did for the video, this would have been a much more rounded notebook.

The company offers a free, 48-hour turnaround repair or replacement service for the first year.—*Michael Bonomo*

Polywell Computers Inc.

Poly NB425C

The Poly NB425C notebook computer combines a 7.2-pound travel weight with a Sanyo passive-matrix color screen, a built-in trackball, and a side-mounted IDE floppy disk drive. But the Poly machine, which sells for \$2,380, does not have a PCMCIA slot, nor is its Cyrix Cx486SLC CPU user-upgradable.

The Poly proved extremely durable

during testing. Beyond ruggedness, however, the system was not a standout performer among the machines we tested. The Poly's CPU test results were average. In addition to this, the machine's display appeared somewhat blotchy, and it was also difficult to read when viewed from an angle.

Also, on PC Labs' battery tests, the Poly's Battery Run-down test time of

1 hour 44 minutes placed it in the lower quarter of this roundup; on the ZDigit Rundown test, with system power-saving features enabled, the Poly lasted for 2 hours 32 minutes.

The keyboard was not a favorite among the reviewers, who thought that the overall feel was sluggish and soft. The right-handers among them said that the built-in trackball had a surprisingly good

Poly NB425C

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **FAIR**



FACT FILE

Poly NB425C

Polywell Computers Inc., 61-C Airport Blvd., San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974

List price: \$2,380

Tested configuration: 4MB 70-ns RAM with OKB of external cache, 84MB Toshiba MK-2024FC IDE hard disk with 32K buffer 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 5.0; Microsoft Windows 3.1; trackball.

Options: Internal 9,600/2,400 fax modem, \$170; additional battery, \$40; docking station, \$500; 486SLC/33, \$100; 8MB upgrade, \$188.

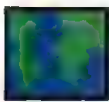
In short: Not a standout performer, the Poly NB425C suffers from poor battery life and a subpar screen



ON READER SERVICE CARD

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feel. But a left-hander in the group was disappointed that the external ports were on the left side of the machine, leaving no place for the user to attach an input device.

Unfortunately, with the Poly NB425C, you get many compromises, but nothing that really sets this machine apart. Given the Toshiba 1800C's superior keyboard and the Dell NL25C's simultaneous display capability, the Poly NB425C appears to lack any special features that overshadow its design compromises.—Mark Schwarz

Polywell Computers Inc.

Poly NB325V

If the Poly NB325V from Polywell Computers seems familiar, it's because you have seen it before—in the form of a Librex Computer Systems notebook. Polywell now sells this unconventional unit since Librex backed out of the U.S. market. This 386SL/25-based portable offers exceptional flexibility and average performance for a low price of \$1,480.

The NB325V offers a comfortable degree of upgradability; upgradable features include hard disk and screen. You can replace the floppy disk drive with an additional battery, and the trackball is actually a removable module that can be

► Poly NB325V

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	FAIR

plugged into the right or left side of the unit or hidden altogether in favor of another pointing device. A two-line LCD status panel clearly displays icons representing information about the unit's current configuration and battery status.

Although most of the NB325V's benchmark test scores were average when compared with the scores of other 386SL/25 machines, the unit turned in consistently above-average results on our Windows Applications tests and disk-intensive operations. On our Battery Rundown test, it scored relatively low: 1 hour 32 minutes. With power-saving features enabled on our ZDigit Rundown



► FACT FILE

Poly NB325V

Polywell Computers Inc., 61-C Airport Blvd., San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974

List price: \$1,480

Tested configuration: 4MB 70-ns RAM with 64K external cache, 84MB Toshiba MK2024FC IDE hard disk with 32K buffer, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, built-in removable trackball

Options: 8MB upgrade, \$225; upgrade to Cyrix 486SLC/33 CPU, \$180; extra battery, \$60, 2,400-/9,600-bps data/fax modem, \$170.

In short: Formerly sold by Librex Computer Systems, Polywell Computers' Poly NB325V is not a cookie-cutter design, standing out in terms of functionality and features

 \$25 ON READER SERVICE CARD

test, it lasted 2 hours 1 minute.

The tradeoff for the modularity is its bulk; the system's travel weight, with battery and AC adapter included, is almost 8 pounds. If you can put up with the weight, however, the NB325V gives you your money's worth in flexibility, as well as a growth path for storage and display devices.—Stephen W. Plain

Samsung Electronics America Inc.

Samsung NoteMaster 486SLC Model S3800

Based on the Cyrix 486SLC/25 processor and featuring a 121MB hard disk, the monochrome Samsung NoteMaster 486SLC Model S3800 is a \$2,678 portable PC that doesn't stand out from the pack.

The NoteMaster's charcoal-gray case feels solid, with sturdy hinges and seams. The keyboard is well-sized and comfortable, but the keys lack adequate travel and

our test unit randomly skipped keys during long typing sessions.

The unit offers a software mouse substitute that uses cursor keys and left-hand Ctrl and Alt keys. Its power-management features include Doze, Standby, and Suspend/Resume.

The NoteMaster turned in disappointing scores on PC Magazine Labs' benchmark tests. Processor and memory performance was average compared with other Cyrix-based products but below average compared with all reviewed machines. Video performance was well below average in both cases, while disk performance was below average for the entire test group but aver-

Samsung NoteMaster 486SLC Model S3800

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	FAIR



► FACT FILE

Samsung NoteMaster 486SLC Model S3800

Samsung Electronics America Inc., 105 Challenger Rd., Ridgefield Park, NJ 07660; 800-446-0262, 201-229-4000; fax, 201-229-4059

List price: \$2,678

Tested configuration: 4MB 70-ns RAM, 121MB Conner CP 2124 IDE hard disk with 32K cache, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1

Options: 2MB RAM upgrade, \$299, 4MB RAM upgrade, \$599, 6MB RAM upgrade, \$899; 2,400-/9,600-bps data/fax modem, \$399

In short: With its not-quite-486-level Cyrix 486SLC/25 CPU, the Samsung NoteMaster seems overpriced for what it offers. The unit turned in midrange scores on many PC Labs benchmark tests

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WordPerfect's Button Bar brings frequently used features right to your screen.

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■ Canon NoteJet 486: *Hybrid Office*

Attempting to create synergy by shoe-horning an ink jet printer into the standard notebook format, Canon has created a new category of personal computing: the mobile office in a briefcase. This extension of the notebook design paradigm opens interesting possibilities, including an end to the cumbersome and expensive practice of faxing documents to your hotel's desk when you're on the road and in need of paper copy. In fact, with the optional modem and appropriate software, the Canon NoteJet 486 can do double-duty as a plain-paper fax machine, either at the office or on the road. What remains to be seen is whether this 7.7-pound printer-notebook hybrid is a breakthrough or the answer to a question that nobody asked.

The result of a joint venture between IBM Japan and Canon, the NoteJet appears on the surface to be unremarkable in all respects—it's slightly large at 12.2 by 10 by 2 inches (HWD), and with a travel weight of 9 pounds, it's a little heavy. Moreover,

the unit lacks a built-in mouse substitute. But this system goes beyond any expectations when you lift the hinged keyboard to reveal the paper feeder for its built-in printer. The NoteJet is truly one-of-a-kind, allowing the user to print graphics and text far from the office, or from an electrical outlet, for



rosoft Windows print drivers work the best but are slower than the built-in fonts, which come in limited sizes. The paper feeder can handle up to ten pages at a time, but it is crudely designed and at times requires a helping hand.

As a result of the system's uninspiring Cyrix 486SLC/25 CPU, processing speed is a double-edged sword: lacking in top-flight performance but easy on battery life. Performance scores were low, reflecting printing- and processor-intensive functions that were tedious at times and irritating at others. On the positive side, the NoteJet lasted 2.5 hours on our Battery Run-down test and an additional 45 minutes on the ZDigit Run-down test.

The list price for the NoteJet is \$2,499, and it comes with a one-year parts and labor guarantee. If you can live with its less-than-stellar performance and can put up with an under-engineered paper feeder, the NoteJet is more than an innovation in a world of look-alike and act-alike products: It's unique.—*Brian Nadel*

age when compared with the other Cyrix 486SLC/25-based machines. Battery times were slightly better than average at 2 hours 27 minutes on the Battery Run-down test and 3 hours 12 minutes on the ZDigit test.

The NoteMaster would make an acceptable low-cost notebook—if it only had the price tag to match.—*OR*

Tenex Computer Express

Tenex 486SLC/25

Although it has nifty pop-out batteries, the 8.9-pound Tenex 486SLC/25 system is heavy and produced below-average performance overall. The exceptions

were high disk and DOSmark scores and good battery life.

The most impressive feature is the easily detachable set of batteries that reside below the display. Pushing the release button on the right causes a battery pack to pop out of its dock, exposing the external disk slot (with two phone jacks). Removing the left battery pack reveals the expansion bus.

With a travel weight hovering around 9 pounds—hefty for a monochrome sys-

tem—and a 12-by-9-inch format, the unit misses the mark in terms of portability. However, the keyboard is more comfortable than many others seen here.

The Tenex's 9.5-inch monochrome display also disappoints by tending to be on the blotchy side, and it is difficult to read if not viewed head-on.

The company is on target in rating this system's battery life at 3 hours; Battery Rundown and ZDigit Rundown times were slightly below and slightly above that level, respectively. Except for video performance scores, the unit consistently ranked first or close to first among Cyrix 486SLC/25 systems in all other benchmark tests.

Tenex includes a prepaid UPS airbill

► Tenex 486SLC/25

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD

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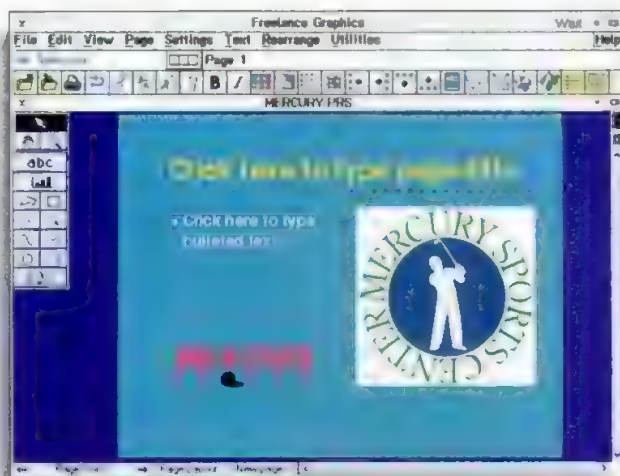
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FACT FILE

Tenex 486SLC/25

Tenex Computer Express, 56800 Magnetic Dr., Mishawaka, IN 46545; 800-776-6781, 219-272-1234; fax, 219-259-0300

List price: \$1,850.

Tested configuration: 4MB 70-ns RAM, 120MB Maxtor hard disk with 8K of cache, 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, BitCom, BitFax, Porta-Point.

Options: 4MB RAM upgrade, \$230; 6MB RAM upgrade, \$300; extra nickel cadmium battery, \$70; Ethernet module, \$250; SCSI interface, \$100.

In short: Good battery life and nice touches, such as easy-to-use pop-out battery packs, help the Tenex 486SLC/25 distinguish itself, despite its mostly below-average benchmark test performance and its disappointing monochrome display. The 8.9-pound unit also misses the mark in terms of portability. The only performance bright spot for the Tenex unit was on PC Magazine Labs' DOS disk tests.



The battery lasted a moderate 2 hours 3 minutes on the Battery Rundown test and 3 hours 47 minutes on the ZDigit Rundown test. The case is about the same size as the T4400C's (2.25 by 11.75 by 8.5 inches), but it weighs less: 7.2 pounds with nickel cadmium battery and 8.4 pounds with battery and AC adapter, versus the T4400C's 8 pounds with battery and 9.8 pounds equipped for



FACT FILE

Toshiba Satellite T1850C

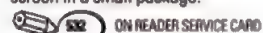
Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000

List price: \$1,800-\$1,900 (estimated street price).

Tested configuration: 4MB 70-ns RAM, 85MB Conner CP2084 IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 2,400-bps data modem, DOS 5.0, Microsoft Windows 3.1, Logitech TrackMan.

Options: 2MB RAM upgrade, \$195; 4MB upgrade, \$309; 8MB upgrade, \$559; extra battery, \$89; 2,400-/9,600-bps data/fax modem, \$259; numeric keypad, \$59; battery charger, \$269; 12-volt battery adapter, \$149; keyboard adapter, \$169; Kensington security lock, \$55.

In short: With an estimated street price of under \$1,900, the Toshiba Satellite T1850C gives you typical Toshiba notebook quality that combines a 386SX/25 CPU, good battery life, and a passive-matrix color screen in a small package.



Toshiba Satellite T1850C

SUITABILITY TO TASK

Road warrior FAIR

DOS applications FAIR

Windows applications FAIR

Desktop replacement FAIR

VENDOR SERVICE & RELIABILITY

Reliability ABOVE AVERAGE

Repair service ABOVE AVERAGE

Technical support ABOVE AVERAGE

the road. The keyboard is responsive and has well-arranged keys. The case's design is better than the T4400C's, including a sliding back port cover, a sliding modem line cover, and better-attached, fold-down access covers than found on the T1850C's predecessor, the discontinued T1800.

If you want passive color and can live without a 486 CPU, the T1850C's under-\$2,000 price tag lets you buy a Toshiba-quality notebook with a color screen for at least \$1,000 less than an active-matrix color system.—Bruce Brown

Toshiba America Information Systems Inc.

Toshiba T4400C

The \$4,858 Toshiba T4400C is an incremental upgrade from its Editors' Choice-winning predecessor, the T4400SXC (December 22, 1992). The T4400C's case doesn't have all of the user convenience and information features found in the T4500 series, but this slightly older model is still a good buy because of its larger display and faster system operation.

The T4400C's strength is a 9.5-inch diagonal active-matrix screen: deep, bright colors and a display still clear when viewed at very wide angles. The keyboard is standard high Toshiba quality: very good feel with full-size keys, inverted-T cursor keys, and separate Home, End, PgUp, and PgDn keys.

The T4400C's battery life is surprisingly good for such a large screen; the nickel cadmium unit kept the system running for 2 hours 22 minutes on the Battery Rundown test, and 4 hours 36 minutes on the ZDigit Rundown test with power-saving features enabled.

This system isn't light; with battery it weighs just under 8 pounds. Add the AC adapter and the weight increases to 9.8 pounds, making it the heaviest system we tested. There is no built-in pointing de-

Toshiba T4400C

SUITABILITY TO TASK

Road warrior GOOD

DOS applications GOOD

Windows applications FAIR

Desktop replacement GOOD

VENDOR SERVICE & RELIABILITY

Reliability ABOVE AVERAGE

Repair service ABOVE AVERAGE

Technical support ABOVE AVERAGE

with every unit to cover shipment for repairs during the first year. There is also a 30-day satisfaction guarantee and toll-free technical support.—Camille N. Cline

Toshiba America Information Systems Inc.

Toshiba Satellite T1850C

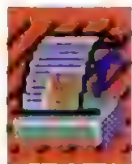
Toshiba is most well-known for notebooks with gorgeous active-matrix color screens, but it also offers passive-matrix color for those who don't want to pay the higher cost. The Satellite T1850C has no suggested list price, but with its 25-MHz 386SX CPU, it can be expected to sell through dealers for about \$1,850 with 4MB RAM and an 80MB hard disk drive.

The display looks best when viewed straight on. From the sides, you'll see the colors and images quickly fade.

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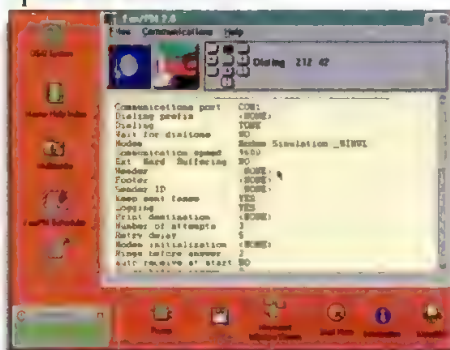
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Mac Envy on the Road

by John R. Quain

While weight, battery life, and price/performance are notebook manufacturers' watchwords, the popularity of Apple's PowerBooks shows that quality design and construction count as well. Apple's PowerBook line breaks into two groups: the PowerBook 145, 160, 165c, and 180, which follow the original chassis design, and the PowerBook Duo Models 210 and 230 (see "Double Duty Duo," in our issue of March 30, 1993). All are based on Motorola's 68030 processor and come with 4MB of RAM.

The entry point in the first family is the PowerBook 145, which comes with a 25-MHz CPU, a 40MB hard disk, a 1.44MB floppy disk drive, and a retail price of \$2,149 (\$2,499 with a 80MB hard disk). Unfortunately, the 145 lacks a video port, cannot be hooked into another Mac's SCSI chain, and uses an eye-straining 1-bit passive-matrix monochrome display. The PowerBook 160 goes a step further by offering a 16-gray-shade display and an external monitor port. The 160 is \$2,429 with a 40MB hard disk, \$2,789 with an 80MB hard disk, and \$3,149 for a 120B configuration. To get a sharper active-matrix screen, you have to move up to the PowerBook 180 (\$4,109 and \$4,469 with an 80MB and 120MB hard disk, respectively). The 180 uses the faster 33-MHz 68030 and the 68882 math coprocessor. If you need a color screen, the Apple PowerBook 165c (\$3,399 with an 80MB hard disk, \$3,759 with a 120MB hard disk) and the 180c (\$4,159 with an 80MB hard disk, \$4,519 with a 160MB hard disk) have recently been added.

For many people, the primary appeal of the PowerBooks is the pointing device. Located below the keyboard, Apple's large two-button trackball sits comfortably between your palms when

you type. To prevent typing fatigue, the PowerBooks also let your wrists rest on the surface below the keyboard. In addition, the PowerBooks' solid construction conveys the impression that they would keep working even if they fell off an apple cart.



Among the PC world's best imitators is Micro Electronics' WinBook 486SLC/E/33, which includes a two-button trackball embedded below the keyboard, though with a narrower wrist rest and a smaller trackball than the PowerBooks have. At \$1,699, the WinBook offers more for the money than a comparable \$3,149 PowerBook 160.

The PowerBooks, which range from just over 6 pounds to over 7 pounds, stand in contrast to the Macintosh Duo Models 210 and 230, both of which weigh about 4.2 pounds. Based on the 68030 processor, they come with an 80MB hard disk. The \$2,249 Duo 210 runs at 25 MHz, while the \$2,609 Duo 230 has a clock speed of 33 MHz. The 230 also comes with a 120MB hard disk option for \$2,969.

Most of the same user-oriented details that attracted PowerBook acolytes are included in the Duos—plus a few more nice details. Brightness and contrast buttons are recessed into the side of the screen, the cover over the Duo's 152-pin docking port connector conveniently slides up and into the back of the computer, and the modem and LocalTalk ports are cleverly hidden behind sturdy latches that swivel

down and support the laptop.

However, the Duos have only the two I/O ports and lack an internal floppy disk drive. Apple designed the 210 and 230 to be used with a desktop Duo Dock, which requires the \$1,079 Duo Dock docking station. The Duo Dock has a 1.44MB floppy disk drive, a mouse, keyboard, two NuBus expansion slots, and room for another hard disk and the full array of Mac connections.

The Duo Dock's motorized mechanism pulls the Duo into the computer as if it were a videotape being sucked into a VCR, automatically charges it while the laptop is inside, and smoothly ejects it when you need it. Unfortunately, in order to keep the Duos slim, Apple reduced the side of the trackball by a third and recessed it into the case.

Infamous for poor battery performance, the PowerBooks have improved but still lag far behind PC notebooks. A modified version of ZD Labs' ZDigit Rundown test conducted on the PowerBook 160 resulted in a time of 1 hour 44 minutes using the notebook's nickel cadmium rechargeable battery. The Duo notebooks use a more advanced nickel hydride battery, but informal tests demonstrated that battery life isn't much better. Compared to power-thrifty 3.3-volt SL-based notebooks, which typically run more than 3 hours, the 5-volt PowerBooks seem like power guzzlers.

If you're drawn by the ergonomics and superior construction of Apple's PowerBooks, remember you'll be paying higher prices, accepting shorter battery life, and leaving most of your DOS applications at home. □

Apple Computer Inc.,
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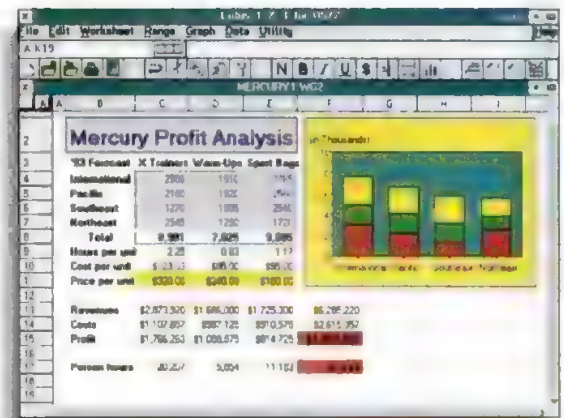
you see how much it offers, you have to give this 1-2-3 a 10.

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FACT FILE

Toshiba T4400C

Toshiba America Information Systems Inc.,
9740 Irvine Blvd., Irvine CA 92718; 800-334-
3445, 714-583-3000

List price: \$4,858.

Tested configuration: 4MB 65-ns RAM, 213MB Toshiba 12-ms MK-2224FC IDE hard disk with 128K cache, 1.44MB floppy disk drive, 14,400-bps data/fax modem, DOS 5.0.

Options: 4MB RAM upgrade, \$309; 8MB RAM upgrade, \$559; 16MB RAM upgrade, \$2,549; docking station, \$849; extra battery, \$279; 14,400-bps data/fax modem, \$475; 17-key numeric keypad, \$59; battery charger, \$279; universal AC adapter, \$165; 12-volt adapter, \$125; keyboard adapter, \$189; 150-pin SCSI adapter, \$245.

In short: The active-matrix color Toshiba T4400C shows the age of its design with its loose port covers and its weight, but it is still a good performer with a particularly good battery life.



ON READER SERVICE CARD

vice, and the system lacks the QuickPort connector found on the T4500 series.

The T4400C has a larger screen and faster 25-MHz 486DX CPU than the T4500C. If all these make up for slightly outmoded user conveniences and heavier weight, this is the unit to buy.—BB

Toshiba America Information Systems Inc.

Toshiba T4500

Toshiba T4500C

The \$3,004 monochrome Toshiba T4500 and the \$3,779 active-matrix color Toshiba T4500C, both 3.3-volt systems, are based on a low-power-consumption version of the Intel 20-MHz 486SX CPU. The two systems share several modern features found on the Toshiba T4400C.

The list of both portables' features includes an LCD status screen that indicates system activity and battery life, a QuickPort attachment port on the right side that allows you to attach the standard Microsoft BallPoint Mouse with ease, a PCMCIA Type II slot, and battery quick charge

that lets you recharge in 2 hours (system off) or 4 hours (system on). The QuickPort is a time saver that does away with hard-to-reach cable plugs. If, however, you prefer an integrated trackball, or if you would rather use a mouse with your left hand, QuickPort does not offer any help.

Toshiba T4500C

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

display systems, the machines have different base hard drives (80MB in the T4500 and 120MB in the T4500C) and utilize different battery technologies. The T4500 uses a monochrome 9.5-inch diagonal backlit display, which looks crisper than most similar screens; function keys used to adjust contrast and brightness quickly cleared up some minimal screen ghosting. The T4500's nickel cadmium battery kept the system going for almost 4 hours on the Battery Run-down test and 6 hours 17 minutes on the ZDigit Run-down test.

Toshiba T4500

SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The T4500C is slightly smaller than the T4400C in all dimensions and weighs about a pound less—with its battery, the T4500C comes in around 7 pounds. The monochrome T4500 weighs just over 6 pounds with its battery pack included.

In addition to having different

The 8.5-inch diagonal active-matrix color screen on the T4500C is quite bright and has very deep colors. The nickel hydride battery powered the T4500C for almost 2 hours on the Run-down test and 4 hours 19 minutes on the ZDigit test.

The T4500 and T4500C are both highly recommended if you can get by with less than the highest-level CPU performance. Each machine features excellent examples of its respective screen technology, and both machines' convenience features reflect concern for users.—Bruce Brown



FACT FILE

Toshiba T4500

Toshiba T4500C

Toshiba America Information Systems Inc.,
9740 Irvine Blvd., Irvine CA 92718; 800-334-
3445, 714-583-3000

List price: T4500, \$3,004; T4500C, \$3,779.

Tested configuration: 4MB 70-ns RAM, 86MB Toshiba MK-1422FC IDE hard disk with 32K cache (T4500), 120MB Toshiba MK-2124FC IDE hard disk with 8K buffer (T4500C), 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem, DOS 5.0, Microsoft Windows 3.1, Microsoft BallPoint Mouse with QuickPort.

Options: 4MB RAM upgrade, \$399; 8MB RAM upgrade, \$679; 16MB RAM upgrade, \$2,549; Desk Station IV docking station, \$849; extra battery, \$149; extra nickel hydride battery, \$299; 2,400-/9,600-bps data/fax PCMCIA Type II modem, \$339; 14,400-/9,600-bps data/fax Type II PCMCIA modem, \$499; battery charger, \$279; 12-volt adapter, \$149.

In short: The above-average monochrome Toshiba T4500 is a good example of current notebook technology, featuring good battery life. If raw CPU power isn't your highest priority, the active-matrix color Toshiba T4500C also has good power-management, one of the brightest screens available, and user-convenience features.



ON READER SERVICE CARD

This TalkThru



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you can work in other applications without interrupting your communications session.

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Compudyne

Compudyne 4DX2/66 Monochrome Slimnote

Compudyne 4DX2/66 Active TFT Color Slimnote

Twinhead Corp.

Twinhead Slimnote 4SX/33M

Twinhead Slimnote 4DX/33T

Twinhead Slimnote 4DX2/66T

Fast, thin, and well designed. That describes the Slimnote computers from Twinhead, but don't be confused by the company name on the case. Twinhead manufactures the Slimnote line under its own name and also allows Compudyne to sell identical units.

In this review we look at five units in all: the Twinhead Slimnote 4DX2/66T (active color screen), Compudyne 4DX2/66 Active TFT Color Slimnote, Compudyne 4DX2/66 Monochrome Slimnote, Twinhead Slimnote 4DX/33T (active color screen), and Twinhead Slimnote 4SX/33M (monochrome).

The Slimnote units perform consistently well across all processor classes. They have the same motherboard and differ in terms of CPU type, battery type, formatted hard disk size, case colors—

dark gray for the Twinhead and off-white for the Compudyne—and screen type.

These units also accounted for three of the four DX2/66 computers in the roundup, so comparison within the CPU group is meaningless. The three DX2/66 models had the highest DOS-mark scores of all tested machines. In addition, their

Compudyne
▶ 4DX2/66 Active
TFT Color Slimnote

SUITABILITY
TO TASK

Road warrior	GOOD
DOS applications	EXCELLENT
Windows applications	GOOD
Desktop replacement	GOOD

VENDOR SERVICE &
RELIABILITY

Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

► SUMMARY OF FEATURES

Portables

List price (tested configuration) Not all portables are available in comparable configurations. We report the price of each system as tested.

Dealers/Direct distribution channel Various machines are sold directly through mail order, through dealers, or, increasingly, through company-owned stores and superstores.

System weight/travel weight The system weight includes the weight of the battery. The travel weight adds that of the AC adapter brick and power cord (but not the external floppy disk drives used in fine systems).

Keys: total, function, cursor The table describes each portable's keyboard: the **total** number of keys, the number of **function** keys, and the number of **cursor** keys. If you have only four cursor keys and you need to access PgUp, PgDn, Home, or End, you hold a function key and tap an arrow key.

Type of pointing device installed A device can be **free-standing** (a normal serial or PS/2-style mouse), **built-in** (built into the unit's case), **clip-on** (a device that clips onto a unit's case and via a cable), and **snap-on** (similar to a clip-on, but needs no cable).

The **BIOS version (or date)** can affect the system's performance on our benchmark tests.

PCMCIA slots accept removable I/O devices roughly the size of a credit card. Currently, add-in components that fit this form factor include expansion memory, nonvolatile SRAM for storage, and modems. There are currently three versions of the PCMCIA standard: Type I, Type II, and Type III.

Internal modem installed indicates the type of modem bundled with the vendor's computer.

Ports for port replicator/expansion chassis Some machines have expansion ports that let the system bus connect to a **port replicator** (which re-creates the I/O ports and can easily be removed from the system without disconnecting all your peripherals) or an **expansion chassis** (which is an external floppy disk drive or full-fledged docking station with additional ports and space for expansion cards).

The chip set and video memory determine the **maximum external resolution** and number of simultaneous colors the external monitor can display at that resolution. Decreasing the resolution setting usually increases the **maximum external colors**.

Illuminated screen/Active matrix An illuminated screen is either backlit, edgelit, or sidelit. **Active-matrix** displays are brighter, provide richer colors or shades of gray, and are easier to view at an angle than passive-matrix screens are.

This table includes each system's **rated battery life** as reported by the vendor. PC Labs also tests the battery life and reports the results in the benchmark test section. The **2Digit Rundown** time shows battery life with power-saving features enabled, and the **Battery Rundown** time provides a worst-case scenario for battery life: No power-conservation features were active. We also indicate the battery **charge time** with the unit on and off, as reported by the vendor.

The **battery weight, amp/hour rating** shows the battery's weight, as well as how long that battery is rated to deliver a steady current of one ampere.

The systems in this review all include power-conservation features, such as automatic **display dimming** or blanking, automatic **hard disk power-down**, slowing or halting the **CPU**, and **peripherals power-down** for removing power to the I/O ports (modem, parallel, and serial ports) when the machine is not in use. More advanced power-management features include **standby** mode (in which a system preserves its current state in memory, usually via a secondary battery) and **hibernation** (in which the system's state is written to the hard disk).

Warranty All systems included in this roundup came with a one-year parts-and-labor warranty or better.

Each system has an **FCC Class B identification number**, which means it has sufficiently low radio-frequency emissions to be used in the home. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072.

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features. Reschedule an appointment by dragging it and dropping it on a new date or time. Drag and drop from the Note palette to create new entries. Drag and drop from the OS/2 Colors and Fonts palettes to customize Relish. Print the schedule for any day just by dragging the date to the printer object. It's

quick and easy—even fun.

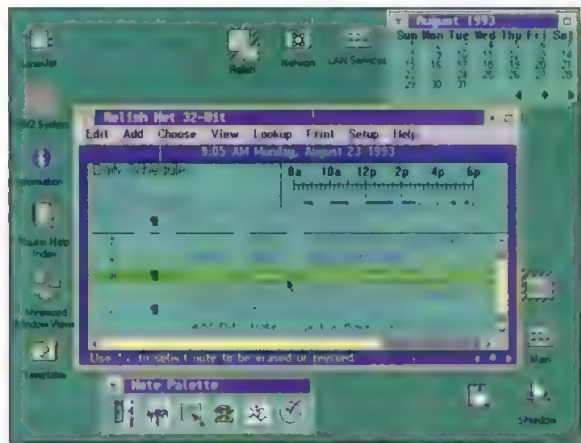
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there's a full course of other time-saving features. Reminders

pop onto your desktop and allow you to make changes without returning to Relish. A program scheduler lets you launch other applications on time. And with Relish's desktop calendar, you just click your mouse to view or change any day's schedule—even when Relish is hidden. And if



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day.

► SUMMARY OF FEATURES

- Monochrome, active
- Monochrome, passive
- Color, active
- Color, passive

Products listed in alphabetical order by company

■ = YES □ = NO

	AST PowerExec EL Color	AST PowerExec 3/25SL Color	AST PowerExec 4/25SL Color Plus	Aurum GoldNote DX2-50	Blue Star 486DX2/66	CAF AquaLITE II
List price (tested configuration)	\$2,799	\$3,499	\$4,499	\$2,395	\$3,495	\$2,399
Processor type and speed	Intel 386SL/25	Intel 386SL/25	Intel 486SL/25	Intel 486DX2/50	Intel 486DX2/66	AMD Am386SXL/25
Hard disk capacity	120MB	160MB	200MB	127MB	210MB	123MB
Dealers/Direct-distribution channel	■ □	■ □	■ □	■ ■	■ ■	■ □
Dimensions (HWD, in inches)	2 x 11.5 x 8.5	2 x 11.5 x 8.5	2 x 11.5 x 8.5	2 x 11.3 x 11	2.3 x 11.5 x 8.5	1.8 x 8.5 x 11
System weight/travel weight (pounds)	6.4, 7.7	6.8, 8.1	7, 8.3	6.8, 8.2	5.9, 8.3	5.5, 6.9
Display area and diagonal (inches)	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	5.8 x 9.3 x 9.5	6 x 7.8 x 9.5
Keys: total, function, cursor	82, 12, 8	82, 12, 8	82, 12, 8	81, 10, 4	85, 12, 8	86, 10, 4
Type of pointing device installed	Snap-on	Snap-on	Snap-on	None	Built-in	None

Motherboard

Motherboard manufacturer	AST	AST	AST	FI	Create Systems	CAF
Chip set manufacturer	Intel	Intel	Intel	Symphony	ACC	VLSI
BIOS version (or date)	AST 2.03	AST 2.10	AST 2.10	AMI (7/7/91)	AMI 4.31	Phoenix (4/19/90)
Setup in ROM/Password in ROM	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

Memory and Disk Drives

Installable RAM	2MB-20MB	4MB-20MB	4MB-32MB	4MB-16MB	4MB-16MB	4MB-8MB
User-installable	■	■	■	□	■	■
External processor RAM cache	None	64K	None	None	8K	None
Available hard disk sizes	60MB-200MB	80MB-200MB	80MB-200MB	80MB-210MB	80MB-210MB	80MB-200MB

I/O and Expansion

Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 2, 0, 1	1, 1, 0, 1	1, 2, 1, 0
High-speed parallel/serial support	■ □	■ □	■ □	□ □	□ □	■ □
Ports for port replicator/expansion chassis	■ ■	■ ■	■ ■	□ ■	□ ■	□ □
PCMCIA slots	One Type II	Two Type II	Two Type II	None	None	None
Internal modem installed	None	None	None	None	9,600-bps fax	2,400-/9,600-bps fax

Video

Screen manufacturer	Sanyo	Sanyo	Hitachi	Hitachi	Sharp	Sharp
Video chip set manufacturer	WD	WD	WD	Cirrus	Cirrus	Cirrus
Simultaneous external display	■	■	■	□	■	■
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	256 colors	256 colors	256 colors	32 gray shades	64 gray shades	64 gray shades
Maximum external resolution	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600
Maximum external colors	16	16	16	256	256	16
Illuminated screen/Active matrix	■ □	■ □	□ ■	■ □	■ □	■ □

AC Adapter and Battery

AC adapter size (inches)	1.5 x 4.8 x 2.8	1.5 x 4.8 x 2.8	1.5 x 4.8 x 2.8	1.5 x 5.5 x 2.5	2.3 x 6.5 x 3	1.5 x 5.5 x 2.8
Rated battery life (hours)	3.5	5	5.5	1.8	3	2
ZDigit Rundown, Battery Rundown (hr:min)	4:03, 1:30	4:48, 1:35	6:17, 2:14	1:47, 1:34	2:48, 1:55	3:02, 2:34
Charge time while on, off (hours)	4, 2	4, 2	1.5, 1	N/A, 4	6, 2.8	2, 2
Battery weight, amp/hour rating	1.4 lbs, 1.7Ah	1.5 lbs, 2.2Ah	1.6 lbs, 2.2Ah	1.1 lbs, 2.8Ah	1.2 lbs, 5Ah	1.1 lbs, 1.7Ah
Display/hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	□ □	□ □	□ □	□ □	□ □	□ □
Standby/Hibernation	■ ■	■ ■	■ ■	□ □	■ □	■ ■

Miscellaneous

DOS version, Microsoft Windows version	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	6.0, 3.1	5.0, 3.1
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
First year on-site service charge	N/A*	N/A*	N/A*	N/A*	\$59	N/A*
FCC Class B identification number	DJKPWRE386-25SL	DJKPWRE386-25SL	DJKPWRE486-25SL	FTVDB486	JXUMLT486 SUPERB	E8HNB5500

N/A*—Not applicable. The product does not have this feature. NA**—Not applicable. The product could not perform this test. ACC—ACC Micro Electronics Inc., AES—Area Electronics Systems Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc., FI—First International Computer Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital.

COVER STORY
Portable PCs

CONTINUES

PC MAGAZINE
EDITORS' CHOICE

Compaq Contura 4/25	Compaq Contura 4/25C	Compaq Contura 4/25CX	Compaq LTE Lite 25E	Compaq LTE Lite 4/25C	CompuAdd Express 425Color	CompuAdd Express 425ColorPlus	CompuAdd Express 425XL	Compudyne 4DX2/66 Active TFT Color Slimnote
(estimated)	\$3,249 (estimated)	\$3,899 (estimated)	\$3,249 (estimated)	\$4,099 (estimated)	\$2,595	\$3,835	\$1,895	\$4,499
486SL/25	Intel 486SL 25	Intel 486SL 25	Intel 386SL 25	Intel 486SL/25	Cyrix Cx486SLC/25	Cyrix Cx486SLC/25	Cyrix Cx486SLC 25	Intel 486DX2, 66
20MB	120MB	115MB	84MB	120MB	128MB	208MB	128MB	213MB
11x8.5	2x11x8.5	2x11x8.5	2x11x8.5	2x11x8.5	2x11.5x8.5	2x11.5x8.5	2x11.5x8.5	2x11x8.5
3.74	6.577	6.98	6.573	6.678	6.578	6.678	6.27.6	6.7.8.2
7.8x9.5	5.8x7.5x9.5	5.3x6.8x8.5	5.7x7.6x9.5	5.1x6.4x8.4	5.1x6.8x8.5	5.3x6.8x8.5	5.8x7.5x9.5	5.3x7x8.5
10.8	10.8	10.8	10.8	10.8	12.8	12.8	12.8	10.8
None	None	Clip-on	Built-in	Built-in	Built-in	Built-in	Built-in	Built-in
Compaq	Compaq	Compaq	Compaq	Compaq	Veridata	Veridata	Veridata	Twinhead
Intel	Intel	Intel	Compaq	Compaq	Headland	Headland	Headland	ACC
Compaq (2/8/93)	Compaq (2/8/93)	Compaq (2/8/93)	Compaq (3/23/92)	Compaq (3/23/92)	Award 4.20	Award 4.20	Award 4.20	Phoenix 1.02
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
8-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	8MB-20MB	8MB-20MB	4MB-20MB	4MB-20MB
None	None	None	64k	None	None	None	None	None
18-209MB	120MB-209MB	120MB-209MB	80MB-120MB	120MB-210MB	128MB	208MB	128MB	213MB-340MB
1,1,0	1,1,1,1	1,1,1,0	1,1,1,0	1,1,1,1	1,1,0,0	1,1,0,0	1,1,0,0	1,1,1,1
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
None	None	None	None	None	None	None	None	None
10 bps fax	9,600 bps fax	9,600 bps fax	14,400-9,600 bps fax	None	9,600 bps fax	9,600 bps fax	9,600 bps fax	None
Sharp	Sharp	Sharp	Compaq	Compaq	Sanyo	Sharp	Sharp	Sharp
Compaq	Compaq	Compaq	Compaq	Compaq	Cirrus	Cirrus	Cirrus	Cirrus
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
ray shades	256 colors	256 colors	32 gray shades	16 colors	256 colors	256 colors	64 gray shades	256 colors
40 x 480	640 x 480	640 x 480	800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	1,024 x 768
16	256	256	16	16	16	16	16	16
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
1.8x5.3x3.3	1.8x5.3x3.3	1.8x5.3x3.3	1.4x5.3x3.3	1.4x5.3x3.3	1.8x6x3	1.8x6x3	1.8x6x3	1.5x6x2.8
3.5	3	3	4	2.5	2	2	3	2.5
42, 228	332, 1:47	301, 1:36	332, 2:57	4:12, 1:52	1:47, 1:35	2:20, 1:32	3:35, 2:30	N/A** 1:53
15.1	15.1	15.1	2.1	2.1	3.5, 3.3	3.5, 3.3	3.5, 3.3	4.2
lbs, 1.7Ah	1.1 lbs, 2.2Ah	1.3 lbs, 2.2Ah	1.3 lbs, 2.2Ah	1.3 lbs, 2.2Ah	1.1 lbs, 2Ah	1.1 lbs, 2Ah	1.1 lbs, 2Ah	1.5 lbs, 2.3Ah
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5	11x8.5
5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1
3 years	3 years	3 years	3 years	3 years	1 year	1 year	1 year	1 year
Included	Included	Included	Included	Included	N/A*	N/A*	N/A*	N/A*
T75MBZ4D	CNT75MBZ4E	CNT75MBZ4F	CNT75MAFAD	CNT75MAFAE	HLOXP69ICC	HLOXP69IC25T	HLOXP69IC	FKGSLIM NOTE-486

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IBM 486 Powered...

System Board Specifications

Technical Specifications

- 100% IBM PC/AT compatible
- CPU: IBM 486SLC2™ -50MHz or 66MHz
- ETEQ 486SLC single core logic chip
- Hardware turbo clock switching
- Software turbo clock switching
- Bus speed changeable
- Easy access to front panel connector settings
- Battery backup for CMOS configuration and real-time clock/calendar
- Board size = 220 mm(W) x 270 mm(L)
- NPU included

BIOS: AMI

Memory:

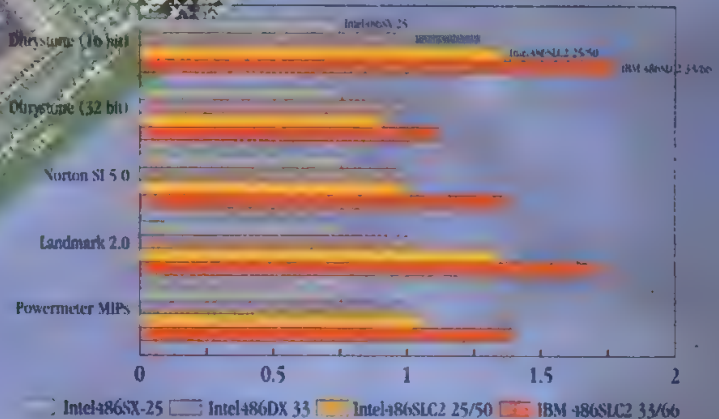
- 64K cache expandable to 128K
- 0M to 16M board memory
- Shadow RAM
- Page Mode memory design
- Unlimited DRAM configurations

Expansion:

- Seven 16-bit Bus slot

- Three years limited warranty on parts and labor provided by IBM
- Manufactured and Tested by IBM
- Made in U.S.A.

Processor Comparison



Performance

486SLC2/50 MHz IBM 486SLC2/66 MHz

PowerMeter 1.5	19.4 MIPS	25.01 MIPS
Landmark v2.0	114.88	153.14
Norton 6.0	67.7	
BAPCo	88.5	

ETEQ
Microsystems, Inc.

1900 McCarthy Blvd., Suite 110
Milpitas, CA 95035, USA
Fax: (408) 432-8146
Tel: (408) 432-8147

All product names are trademarks or registered trademarks of their respective owners.

CIRCLE 369 ON READER SERVICE CARD

► SUMMARY OF FEATURES

Products listed in alphabetical order by company	Compudyne 4DX2/66 Monochrome Slimnote	Compudyne 4SL/25 Subnote	Dell NL25	Dell NL25C	Dell 325N	Dell 325NC
■ = YES □ = NO						
List price (tested configuration)	\$2,999	\$2,138	\$1,949	\$2,449	\$2,798	\$3,298
Processor type and speed	Intel 486DX2/66	Intel 486SL/25	Intel 386SL/25	Intel 386SL/25	Intel 386SL/25	Intel 386SL/25
Hard disk capacity	213MB	80MB	115MB	115MB	208MB	208MB
Dealers/Direct-distribution channel	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Dimensions (HWD, in inches)	1.5 x 11 x 8.5	1.5 x 10 x 7.3	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5
System weight/travel weight (pounds)	6.2, 7.8	3, 5.4	6.4, 8	6.7, 7.9	6.5, 7.6	7.3, 8.3
Display area and diagonal (inches)	5.8 x 7.5 x 9.5	4.5 x 6 x 7.5	5.8 x 7.5 x 9.5	5 x 7.3 x 9	5.8 x 7.5 x 9.5	5.5 x 7.3 x 9
Keys: total, function, cursor	84, 10, 8	80, 10, 4	85, 12, 4	85, 12, 4	85, 12, 4	85, 12, 4
Type of pointing device installed	Built-in	Built-in	Clip-on	Clip-on	Clip-on	Clip-on
Motherboard						
Motherboard manufacturer	Twinhead	Twinhead	Dell	Dell	Dell	Dell
Chip set manufacturer	ACC	ACC	Intel	Intel	Intel	Intel
BIOS version (or date)	Phoenix 1.02	Phoenix 1.03	Phoenix (2/8/93)	Phoenix (2/24/93)	Phoenix (10/30/92)	Phoenix (10/30/92)
Setup in ROM/Password in ROM	■ ■	■ ■	■ □	■ ■	■ ■	■ ■
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Memory and Disk Drives						
Installable RAM	4MB-20MB	4MB-20MB	4MB-8MB	2MB-8MB	4MB-12MB	4MB-12MB
User-installable	■	■	■	■	■	■
External processor RAM cache	None	None	64K	64K	64K	64K
Available hard disk sizes	213MB-340MB	80MB-120MB	80MB-120MB	80MB-200MB	80MB-120MB	80MB-120MB
I/O and Expansion						
Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 0
High-speed parallel/serial support	□ □	■ □	□ □	□ □	■ □	■ □
Ports for port replicator/expansion chassis	□ ■	□ □	□ □	□ □	□ □	□ □
PCMCIA slots	None	One Type II	None	None	None	None
Internal modem installed	None	2,400-/9,600-bps fax	14,400-/9,600-bps fax	9,600-bps fax	9,600-bps fax	9,600-bps fax
Video						
Screen manufacturer	Sharp	Sharp	Sharp	Sharp	Sharp	Sharp
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	Cirrus	WD	WD
Simultaneous external display	■	■	□	■	□	□
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	64 gray shades	64 gray shades	32 gray shades	16 colors	64 gray shades	16 colors
Maximum external resolution	1,024 x 768	640 x 480	800 x 600	800 x 600	800 x 600	800 x 600
Maximum external colors	16	16	16	16	16	16
Illuminated screen/Active matrix	■ □	■ □	■ □	■ □	■ □	■ □
AC Adapter and Battery						
AC adapter size (inches)	1.8 x 6.5 x 3	1.3 x 4 x 2.5	1.8 x 2.8 x 6	1.8 x 2.8 x 6	1.5 x 2.3 x 4.5	1.5 x 2.3 x 4.5
Rated battery life (hours)	2.5	4.5	2.5	2.5	4	4
ZDigit Rundown, Battery Rundown (hr:min)	N/A**, 2:48	N/A**, 3:07	3:16, 2:43	3:01, 2:19	7:00, 3:53	5:31, 2:52
Charge time while on, off (hours)	4, 2	4, 2	10, 2	10, 2	12, 3.5	12, 3.5
Battery weight, amp/hour rating	1.3 lbs, 2.3Ah	0.9 lbs, 2.3Ah	1.3 lbs, 1.7Ah	1.4 lbs, 1.7Ah	1.6 lbs, 2.2Ah	1.6 lbs, 2.2Ah
Display/hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ □	■ ■	■ ■	■ ■	■ ■	■ ■
Standby/Hibernation	■ □	■ ■	■ ■	■ ■	■ ■	■ ■
Miscellaneous						
DOS version, Microsoft Windows version	6.0, 3.1	6.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
First year on-site service charge	N/A*	N/A*	Included	\$99	Included	Included
FCC Class B identification number	FKGSLIMNOTE-486	FKGSBN-4SL	DGID3216	DGI-D3218	E2K325N	E2K325NC

N/A*—Not applicable. The product does not have this feature. N/A**—Not applicable. The product could not perform this test. ACC—ACC Micro Electronics Inc. AES—Area Electronics Systems Inc. C&T—Chips & Technologies Inc., DTI—Display Technologies Inc., FI—First International Computer Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital

COVER STORY
Portable PCs

CONTINUES

PC MAGAZINE **PC MAGAZINE**
EDITORS' CHOICE EDITORS' CHOICE

Intel 325SLi	Digital DECpc 325SL	Digital DECpc 325SLC	Digital DECpc 425SL	Epson ActionNote 4SLC/25	Ergo PowerBrick 486	Gateway Nomad 425SXL	Gateway Nomad 450DXL	GRiD Convertible
\$2,264	\$2,099	\$2,899	\$2,499	\$1,649	\$1,995	\$1,995	\$2,995	\$4,790
386SL/25	Intel 386SL/25	Intel 386SL/25	Intel 486SL/25	Cyrix Cx486SLC/25	Intel 486DX/33	Intel 486SX/25	Intel 486DX2/50	Intel 386SL/25
213MB	84MB	84MB	120MB	131MB	120MB	128MB	208MB	125MB
■ ■	■ ■	■ ■	■ ■	■ ■	□ ■	□ ■	□ ■	■ ■
11 x 7.8	2 x 11.5 x 8.3	2 x 11.5 x 8.3	2 x 11.5 x 8.5	1.8 x 11 x 8.8	1.8 x 11.3 x 8.8	1.8 x 11 x 8.5	1.8 x 11 x 8.5	1.5 x 11.5 x 9.3
7.4, 4.8	6.9, 7.6	6.9, 8.2	6.3, 7.4	5.5, 7.1	5.3, 8.4	5.7, 6.9	5.6, 6.9	5.7, 7.2
7.8 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.5 x 9.5	6 x 8 x 9.8	6 x 8 x 9.8	6 x 7.8 x 9.5
5, 12, 4	82, 12, 8	82, 12, 8	82, 12, 8	84, 12, 8	84, 10, 4	79, 10, 4	79, 10, 4	79, 12, 4
Clip-on	Snap-on	Snap-on	Snap-on	Clip-on	Built-in	Free-standing	Clip-on	Built-in

Dell	AST	AST	AST	Epson	AES	TI	TI	GRiD
Intel	Intel	Intel	Intel	ACC	WD	TI	TI	Intel
Cyrix (2/2/93)	AST 1.01	DEC 1.01	AST 2.03	AMI (5/5/91)	Award (12/12/91)	Phoenix 1.03	Phoenix 1.04	Phoenix (9/18/92)
■ ■	■ ■	■ ■	■ ■	■ ■	■	■ ■	■ ■	□ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

18-10MB	4MB-20MB	4MB-20MB	4MB-32MB	4MB-8MB	4MB-20MB	4MB-20MB	8MB-20MB	2MB-8MB
■	■	■	■	■	■	■	■	■
16K	64K	64K	8K	None	None	None	None	64K
18-200MB	80MB-200MB	80MB-200MB	80MB-200MB	80MB-131MB	120MB-350MB	128MB-208MB	128MB-208MB	125MB

1, 0, 0	1, 1, 1, 1	1, 1, 1, 1	2, 1, 1, 1	1, 2, 1, 0	1, 1, 1, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 0
■ □	■ □	■ □	□ □	□ ■	□ □	□ □	■ ■	■ ■
□ □	■ ■	■ ■	■ ■	□ □	□ □	□ □	□ □	□ □
One Type II	Two Type II	Two Type II	Two Type II	None	None	None	None	One Type II
1,960-bps fax	None	None	None	2,400-/9,600-bps fax	2,400-/9,600-bps fax	9,600-bps fax	None	1,400-/9,600-bps fax

Sharp	AST	AST	AST	Hitachi	Toshiba	Sharp	Sharp	Sharp
Cirrus	WD	WD	WD	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus
■	■	■	■	■	■	■	■	■
40 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
gray shades	64 gray shades	256 colors	64 gray shades	32 gray shades	64 gray shades	64 gray shades	64 gray shades	64 gray shades
800 x 600	800 x 600	800 x 600	800 x 600	800 x 600	1,024 x 768	800 x 600 interlaced	1,024 x 768 interlaced	640 x 480
16	16	16	16	16	16	16	16	256
□ □	■ □	■ □	■ □	■ □	■ □	■ □	■ □	■ □

1.5 x 2.3 x 4.5	1.5 x 4.5 x 2.8	1.5 x 4.5 x 2.8	1.5 x 4.8 x 2.8	1.8 x 6.3 x 3	1.8 x 6.3 x 3	1.5 x 2.3 x 6	1.5 x 2.3 x 6	1.5 x 2.8 x 6
3.5	6.5	6	6	2	1.8	6.5	6.5	3
A*, 2:55	8:33, 3:41	5:02, 2:20	9:34, 4:03	2:02, 1:45	2:24, 1:56	6:46, 2:58	5:32, 2:16	2:01, 1:37
12, 1.8	1.5, 1	1.5, 1	1.5, 1	3.5, 3.5	4, 2	2.8, 2.8	2.8, 2.8	1.5, 1.5
1.5 lbs, 2.2Ah	1.5 lbs, 2.2Ah	1.5 lbs, 2.2Ah	1.5 lbs, 2.2Ah	0.8 lbs, 1.7Ah	1.4 lbs, 2.1Ah	1.3 lbs, 5.7Ah	1.2 lbs, 5.7Ah	0.77 lbs, 2Ah
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	□ □	■ □	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ □	■ □	■ □

5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	6.0, 3.1	6.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, Pen Windows
1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
Included	N/A*	N/A*	N/A*	Included	N/A*	N/A*	N/A*	N/A*
2K325SLi	DJKPWRE386-25SL	DJKPWRE386-25SL	DJKPWRE486-25SL	JRUAN-4S25	JRUANT-4D33	A92T48625	A92486DX2	F2J2260

► **S U M M A R Y O F F E A T U R E S**

PC MAGAZINE
EDITORS' CHOICE

Products listed in alphabetical order by company ■ = YES □ = NO	HyperBook 2300DLC/40	HyperBook 2300DX2/50	Hyundai Courier	Hyundai Courier Spectra	IBM ThinkPad 720C	Jetta Jetbook 486DX/33
List price (tested configuration)	\$3,695	\$4,195	\$1,199	\$2,499	\$4,695	\$2,345
Processor type and speed	Cyrix Cx486DLC/40	Intel 486DX2/50	AMD Am386SXL 25	Cyrix Cx486SLC/25	IBM 486SLC2	Intel 486DX/33
Hard disk capacity	213MB	213MB	85MB	120MB	160MB	213MB
Dealers: Direct-distribution channel	■ □	■ □	■ ■	■ ■	■ ■	■ □
Dimensions (HWD, in inches)	2.4 x 11 x 8.8	2.4 x 11 x 8.8	1.8 x 11 x 8.5	2.3 x 11 x 8.8	2 x 11.8 x 8.3	2 x 11 x 9
System weight/travel weight (pounds)	6.9, 8.3	6.9, 8.3	5.7, 6.9	5.7, 7.4	7.4, 8.9	6.6, 8
Display area and diagonal (inches)	5.3 x 7.2 x 8.9	5.3 x 7.2 x 8.9	5.8 x 7.8 x 9.5	5 x 6.8 x 8.5	6.5 x 8.5 x 10.5	5.8 x 7.5 x 9.5
Keys: total, function, cursor	84, 10, 8	84, 10, 8	84, 10, 4	86, 12, 8	84, 12, 4	86, 12, 8
Type of pointing device installed	None	None	Built-in	Built-in	Built-in	None
Motherboard						
Motherboard manufacturer	SunRace	SunRace	Hyundai	IBM/Lexmark	IBM	Jetta
Chip set manufacturer	Symphony	Symphony	WD	WD	IBM	C&T
BIOS version (or date)	AMI (3/9/93)	AMI (3/9/93)	Phoenix 1.01	Phoenix 1.01	IBM (1/29/93)	AMI (11/10/92)
Setup in ROM, Password in ROM	■ ■	■ ■	■ □	■ □	□ ■	■ ■
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Memory and Disk Drives						
Installable RAM	4MB-20MB	4MB-20MB	2MB-8MB	4MB-16MB	4MB-16MB	4MB-16MB
User-installable	■	■	■	□	■	■
External processor RAM cache	128K	256K	None	None	None	8K
Available hard disk sizes	130MB-210MB	130MB-340MB	60MB-120MB	120MB-170MB	160MB-240MB	86MB-213MB
I/O and Expansion						
Parallel, serial, mouse, expansion ports	1, 2, 1, 0	1, 2, 1, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
High-speed parallel/serial support	□ □	□ □	□ □	□ □	■ □	□ ■
Ports for port replicator/expansion chassis	□ □	□ □	□ □	□ □	□ ■	□ ■
PCMCIA slots	None	None	One Type II	None	Two Type II	None
Internal modem installed	2,400-/9,600-bps fax	2,400-/9,600-bps fax	None	2,400-/9,600-bps fax	None	2,400-/9,600-bps fax
Video						
Screen manufacturer	Hitachi	Hitachi	Sanyo	Sanyo	DTI	Hitachi
Video chip set manufacturer	Cirrus	Cirrus	C&T	WD	IBM	Cirrus
Simultaneous external display	□	□	■	□	■	■
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	64 gray shades	64 gray shades	64 gray shades	16 colors	256 colors	64 gray shades
Maximum external resolution	800 x 600	800 x 600	640 x 480	800 x 600	640 x 480	800 x 600
Maximum external colors	256	256	16	16	256	16
Illuminated screen/Active matrix	■ □	■ □	■ □	■ □	■ ■	■ □
AC Adapter and Battery						
AC adapter size (inches)	2 x 5.9 x 2.9	2 x 5.9 x 2.9	1.5 x 2.3 x 5.5	1.8 x 5.8 x 3	1.5 x 2.8 x 5.5	1.8 x 2.5 x 6
Rated battery life (hours)	1.5	1.5	2	2	2.6	3.5
ZDigit Rundown, Battery Rundown (hr:min)	1:47, 1:36	N/A**, 1:46	2:02, 1:55	1:59, 1:23	4:03, 1:59	2:33, 2:18
Charge time while on, off (hours)	7, 1.1	7, 1.1	3, 1	3, 1	1.5, 1.4	2, 2
Battery weight, amp/hour rating	1.3 lbs, 2.8Ah	1.3 lbs, 2.8Ah	1 lbs, 1.7Ah	0.7 lbs, 1.4Ah	1.5 lbs, 2.9Ah	1.7 lbs, 2.8Ah
Display/hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ □	■ □	■ ■	■ ■	■ ■	■ □
Standby/Hibernation	■ □	■ □	■ □	■ □	■ □	■ □
Miscellaneous						
DOS version, Microsoft Windows version	6.0, None	6.0, None	5.0, 3.1	5.0, 3.1	5.02, None	5.0, None
Warranty	15 months	15 months	18 months	18 months	3 years	1 year
First year on-site service charge	N/A*	N/A*	Included	Included	\$40	N/A*
FCC Class B identification number	J75HB2300D3	J75HB2300D2	CKLNB386LE 25	IYL1366728	AN09552CP	IQ7486-33J

N/A*—Not applicable. The product does not have this feature. N/A**—Not applicable. The product could not perform this test. ACC—ACC Micro Electronics Inc., AES—Area Electronics Systems Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc., FI—First International Computer Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital

Micro electronics inBook SLC/E/33	Micro Express NP943 Notebook PC	Mitsuba Ninja 486SX/25	NEC UltraLite Versa 25C	Packard Bell 486DX/25 Notebook	PC Brand Active Color LeaderBook Pro	Poly NB325V	Poly NB425C	Samsung NoteMaster 486SLC Model S3800
\$1,799	\$1,899	\$1,895	\$4,269	\$1,999	\$3,994	\$1,480	\$2,380	\$2,678
Cx486SLC	Intel 486DX/33	Intel 486SX/25	Intel 486SL/25	Intel 486DX/25	Intel 486DX/33	Intel 386SL/25	Cyrix Cx486SLC/25	Cyrix Cx486SLC/25
28MB	123MB	123MB	120MB	123MB	121MB	84MB	84MB	121MB
□ ■	□ ■	■ □	■ □	■ □	□ ■	■ ■	■ ■	■ □
11.3 x 8.8	2 x 12 x 9.5	2 x 11 x 8.5	2.1 x 11.7 x 9.3	1.3 x 11 x 8.5	2 x 11.3 x 9	2 x 11.7 x 8.6	1.8 x 11 x 8.5	2 x 11 x 8.5
5.5, 7	7.2, 8.4	6.9, 7.9	6.9, 8.6	5.1, 8	6.9, 8.6	6.8, 7.9	6, 7.2	6.4, 7.8
7.8 x 9.5	5.8 x 7.8 x 9.5	5.8 x 7.5 x 9.5	5.8 x 7.8 x 9.5	5.8 x 7.5 x 9.5	5.3 x 6.8 x 8.5	5.8 x 7.6 x 9.5	5.1 x 6.9 x 8.5	5.8 x 7.5 x 9.5
4, 10, 4	84, 10, 8	70, 12, 4	83, 12, 4	80, 12, 4	84, 10, 8	85, 12, 4	82, 12, 4	80, 12, 4
Built-in	Free-standing	None	Clip-on	Free-standing	None	Snap-on	Built-in	None

Jetta	Micro Express	Mitsuba	NEC	Packard Bell	PC Brand	Vinsotec	Compaq	Samsung
Motorola	ACC	ACC	Intel	ACC	ACC	Intel	VLSI	Motorola
(12/12/91)	AMI (10/5/92)	Award 4.20	Phoenix (4/19/90)	Award Q3H	AMI (12/12/91)	Phoenix 3.02	Phoenix 3.01	Phoenix 1.01A
■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ ■	■ ■	■ □
■ □	■ ■	□ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ □

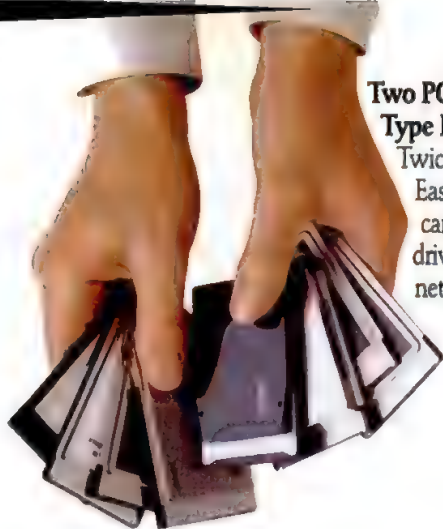
MB-8MB	4MB-16MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	2MB-20MB	4MB-8MB	2MB-8MB
□	■	□	■	■	■	■	■	■
None	None	None	None	None	None	64K	None	None
MB-250MB	80MB-200MB	120MB-210MB	120MB-240MB	123MB	80MB-200MB	130MB-200MB	130MB-200MB	80MB-121MB

1, 1, 1, 1	1, 1, 0, 1	1, 1, 1, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 0, 0	1, 1, 1, 1	1, 1, 0, 1	1, 1, 1, 0
□ □	□ ■	□ □	■ □	□ □	□ □	□ □	□ □	□ □
□ ■	□ □	□ □	□ ■	□ □	□ □	□ □	□ □	□ □
one Type II	None	None	Two Type II or one Type III	None	None	None	None	None
-/9,600-bps fax	2,400-/9,600-bps fax	None	None	2,400-/9,600-bps send-only fax	2,400-/9,600-bps fax	None	2,400-/9,600-bps fax	None

Hitachi	Sanyo	Sharp	NEC	Packard Bell	Sharp	Sanyo	Sanyo	Sharp
Cirrus	Cirrus	Cirrus	C&T	Cirrus	Cirrus	Epson	Cirrus	Cirrus
■	□	■	■	■	■	■	□	■
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	800 x 600	640 x 480
gray shades	64 gray shades	64 gray shades	256 colors	64 gray shades	256 colors	32 gray shades	16 colors	64 gray shades
800 x 600	640 x 480	800 x 600	1,024 x 768	800 x 600	1,024 x 768	800 x 600	800 x 600	640 x 480
256	256	16	16	16	16	16	16	16
■ □	■ ■	■ □	■ ■	■ □	■ ■	■ □	■ □	■ □

2.8 x 5.8	2 x 5.3 x 2.8	1.5 x 4.5 x 3	2 x 3 x 7	1.5 x 5.8 x 3	1.8 x 6 x 3	1.6 x 5.1 x 2.3	1.5 x 5.5 x 2.8	1.8 x 4.8 x 3.3
3.5	2.5	3	2.3	2.5	3	6	3.5	2.5
3:47, 3:28	4:18, 3:27	2:48, 2:04	3:32, 2:00	3:03, 2:39	N/A**, 1:24	2:01, 1:32	2:32, 1:44	3:12, 2:27
2, 1.5	3, 2	3, 2	2.8, 1.4	1.5, 1.5	2, 2	4.5, 1.5	3, 2	5, 3
8 lbs, 2.2Ah	1.9 lbs, 1.4Ah	1 lbs, 2.2Ah	1.1 lbs, 3.4Ah	1.4 lbs, 2.3Ah	1.4 lbs, 2.8Ah	0.8 lbs, 5.0Ah	1.3 lbs, 5Ah	1.2 lbs, 2.4Ah
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	□ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ □	■ □	■ ■	■ ■	■ ■	■ ■	■ □	■ □	■ □

6.0, 3.1	6.0, 3.1	5.0, None	6.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, None
1 year	15 months	1 year	3 years	1 year	1 year	15 months	1 year	1 year
N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Q7486SLC	GS6NP-943	HF5CK4	A3DP50	HF5SK4	JRVANC4D33	EF7A125MI	IIRT34XC-25	A3LS3800



**Two PCMCIA 2.01 Slots,
Type II (5mm) and 16mm:**
Twice the expandability.
Easily accepts multiple
cards including hard disk
drives, modems and
network adapters.



LCD Status Bar: Delivers an instant read of the
battery life remaining, power-saving mode, and
a host of other key notebook settings.



Blazing 33MHz i486™ SL:
With built-in coprocessor
support, delivers the
ultimate in notebook
processing power.

Some say the T4600 is Because in life, there

T4600C

- 9.5" color active matrix TFT-LCD screen
- 120/200/320MB HDD
- 6.9 lbs.
- NiMH battery

T4600

- 9.5" high-contrast, black and white LCD screen
- 120/200MB HDD
- 6.4 lbs.
- NiCd battery

BOTH MODELS

- Intel 486SL/ 33MHz, 3.3 volt processor with 8K cache
- 4MB RAM expandable to 20MB
- Two PCMCIA 2.01 slots, Type II (5mm) and 16mm
- BallPoint™ mouse w/QuickPort™
- Toshiba MaxTime™ Power Management system, and extensive 3.3v components provide industry-leading battery life.
- Pre-installed software: DOS 6.0, Windows® 3.1, and UltraFont™



Large 9.5" Color Active Matrix TFT-LCD Screen: This exceptional technology delivers spectacular color for vivid graphics and dazzling presentations.





BallPoint™ Mouse with QuickPort™: Attaches easily, without messy cords, for ergonomically ideal input—perfect for Windows® applications.



Replace Your Desktop: Just snap your notebook into the Desk Station IV, and you're instantly connected to your printer, VGA monitor, mouse, and full-size keyboard. Now you only need one computer.



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Get the awesome power of a 33MHz i486™ SL processor, and don't sacrifice battery life. Add a 9.5" color active matrix TFT-LCD screen, and access all 185,193 eye-popping VGA colors. Pack a massive 320MB hard drive and never have to leave a file at home.

Get your hands on the BallPoint™ mouse, snap it into its QuickPort™, and never waste a moment or a motion.

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Glance at the QuickRead LCD status icon bar for an instant read of battery life, power

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In Touch with Tomorrow
TOSHIBA

► SUMMARY OF FEATURES

PC MAGAZINE
EDITORS' CHOICE

Products listed in alphabetical order by company	Santron 486 Jetbook	Tenex 486SLC/25	Tenex 486DX/33 Chroma	TI TravelMate WinSLC 25	TI TravelMate 4000 WinDX/25	TI TravelMate 4000 WinDX2/40 Color
■ = YES □ = NO						
List price (tested configuration)	\$2,120	\$1,850	\$3,100	\$1,899	\$2,799	\$4,199
Processor type and speed	Intel 486DX/33	Cyrix Cx486SLC/25	Intel 486DX/33	TI 486SLC/25	Intel 486DX/25	TI DX2/40
Hard disk capacity	86MB	120MB	213MB	64MB	128MB	208MB
Dealers/Direct-distribution channel	□ ■	■ ■	■ ■	■ □	■ □	■ □
Dimensions (HWD, in inches)	2 x 11 x 9	2.2 x 12 x 9.4	2.2 x 12 x 9.5	1.8 x 11 x 8.5	1.8 x 11 x 8.5	1.9 x 11 x 8.5
System weight/travel weight (pounds)	6.6, 8	7.5, 9	7.7, 9	5.6, 6.8	5.6, 6.9	6.2, 7.5
Display area and diagonal (inches)	5.8 x 7.5 x 9.5	5.8 x 7.6 x 9.5	5.2 x 6.9 x 8.5	6 x 8 x 9.8	6 x 8 x 9.8	5.8 x 7.7 x 9.4
Keys: total, function, cursor	86, 12, 4	84, 12, 8	84, 12, 8	79, 10, 4	79, 10, 4	79, 10, 4
Type of pointing device installed	Built-in	C. p-on	C. p-on	Cl p-on	Cl p-on	Cl p-on
Motherboard						
Motherboard manufacturer	Jetta	Notestar	Notestar	TI	TI	TI
Chip set manufacturer	C&T	C&T	C&T	TI	TI	TI
BIOS version (or date)	AMI 4.00	AMI (6/13/90)	AMI (7/7/91)	Phoenix 1.02	Phoenix 1.02	Phoenix 1.02
Setup in ROM/Password in ROM	■ ■	■ □	■ ■	■ ■	■ □	■ ■
System shadowing/Video shadowing	■ ■	■ ■	□ ■	■ ■	■ □	■ ■
Memory and Disk Drives						
Installable RAM	4MB-16MB	2MB-8MB	4MB-16MB	4MB-6MB	8MB-20MB	8MB-20MB
User-installable	■	□	■	■	■	■
External processor RAM cache	32K	None	None	None	None	None
Available hard disk sizes	85MB-210MB	80MB-210MB	80MB-210MB	64MB-80MB	128MB-200MB	208MB
I/O and Expansion						
Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
High-speed parallel/serial support	□ □	□ □	□ □	□ □	□ □	□ □
Ports for port replicator/expansion chassis	□ □	□ ■	□ □	■ ■	■ ■	■ ■
PCMCIA slots	None	None	None	None	None	None
Internal modem installed	2,400-/9,600-bps fax	2,400-/9,600-bps fax	2,400-/9,600-bps fax	None	None	None
Video						
Screen manufacturer	Hitachi	Sharp	Sharp	Sharp	Sharp	Sanyo
Video chip set manufacturer	Cirrus	C&T	Cirrus	Cirrus	Cirrus	Cirrus
Simultaneous external display	■	■	■	■	■	■
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal gray shades or colors	64 gray shades	64 gray shades	16 colors	64 gray shades	64 gray shades	256 colors
Maximum external resolution	800 x 600	640 x 480	800 x 600	640 x 480	1,024 x 768	1,024 x 768
Maximum external colors	16	16	16	256	16	16
Illuminated screen/Active matrix	■ □	■ □	■ □	■ □	■ □	■ □
AC Adapter and Battery						
AC adapter size (inches)	1.8 x 5.8 x 3.5	1.6 x 6 x 2.5	1.9 x 5.3 x 5.3	1.5 x 2.3 x 6	1.5 x 2.3 x 6	1.6 x 6 x 2.3
Rated battery life (hours)	2.5	3	3	4	4	3.5
ZDigit Rundown, Battery Rundown (hr:min)	2:50, 2:23	3:17, 2:59	2:47, 2:02	4:01, 3:43	4:00, 1:47	4:12, 2:15
Charge time while on, off (hours)	2, 2	5, 3	5, 1	3, 3	3, 3	3, 3
Battery weight, amp/hour rating	1.4 lbs, 1.9Ah	1.9 lbs, 1.4Ah	2.9 lbs, 1.4Ah	1.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah
Display/hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ □	■ ■	■ ■	■ ■	■ ■	■ ■
Standby/Hibernation	■ ■	■ □	■ □	■ □	■ □	■ □
Miscellaneous						
DOS version, Microsoft Windows version	5.0, 3.1	6.0, 3.1	5.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
First year on-site service charge	N/A*	N/A*	N/A*	N/A*	\$129	\$129
FCC Class B identification number	IQ7486-BASE	GS6NP-942	GS6NP-943C	A92TSLC25	A92T48625	A92486DX2C

N/A* - Not applicable. The product does not have this feature. NA** - Not applicable. The product could not perform this test. ACC - ACC Micro Electronics Inc., AES - Area Electronics Systems Inc., C&T - Chips & Technologies Inc., DTI - Display Technologies Inc., FI - First International Computer Corp., TI - Texas Instruments Inc., VLSI - VLSI Technology Inc., WD - Western Digital



TravelMate WinDX2/50	TI TravelMate 4000 WinSX/25	TI TravelMate 4000 WinSX/25 Color	Toshiba Satellite T1850C	Toshiba T4400C	Toshiba T4500	Toshiba T4500C	Twinhead Slimnote 4DX/33T	Twinhead Slimnote 4DX2/66T
\$3,499	\$2,199	\$2,999	\$1,850 (estimated)	\$4,858	\$3,004	\$3,799	\$3,899	\$4,499
486DX2/50	Intel 486SX/25	Intel 486SX/25	Intel 386SX/25	Intel 486DX/25	Intel 486SX/20	Intel 486SX/20	Intel 486DX/33	Intel 486DX2/66
208MB	128MB	128MB	80MB	213MB	86MB	120MB	203MB	203MB
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
11 x 8.5	18 x 11 x 8.5	23 x 11 x 8.5	23 x 11.8 x 8.5	23 x 11.8 x 8.4	18 x 11.5 x 8.3	2 x 11.5 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5
4.4, 6.9	5.6, 6.9	6.1, 7.4	7.2, 8.4	8, 9.9	6.3, 7.5	7, 8.2	6.7, 8.2	6.8, 8.3
8 x 9.8	6 x 8 x 9.8	5.8 x 7.7 x 9.5	5.8 x 7.5 x 9.5	5.7 x 7.6 x 9.5	5.8 x 7.5 x 9.5	5 x 6.8 x 8.5	5.3 x 6.9 x 8.5	5.3 x 6.9 x 8.5
9, 10, 4	7.9, 10, 4	7.9, 10, 4	8.2, 12, 8	8.2, 12, 8	8.2, 12, 8	8.2, 12, 8	8.4, 10, 8	8.4, 10, 8
Clip-on	Clip-on	Clip-on	Clip-on	None	Snap-on	Snap-on	Built-in	Built-in
TI	TI	TI	Toshiba	Toshiba	Toshiba	Toshiba	Twinhead	Twinhead
TI	TI	TI	Toshiba	Toshiba	Toshiba	Toshiba	ACC/Twinhead	ACC/Twinhead
Phoenix 1.02	Phoenix 1.02	Phoenix 1.02	Toshiba (7/17/92)	Toshiba (10/7/92)	Toshiba 1.10	Toshiba 1.10	Phoenix (2/15/93)	Phoenix (3/15/93)
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
4MB-20MB	8MB-20MB	8MB-20MB	4MB-12MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB	4MB-20MB
□	□	□	□	□	□	□	□	□
None	None	None	None	None	None	None	None	None
208MB	128MB	128MB	80MB-120MB	80MB-120MB	120MB-200MB	120MB-200MB	130MB-203MB	203MB
1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
None	None	None	None	None	One Type I	One Type II	None	None
None	None	None	2,400-bps data	14,400-bps fax	2,400-/9,600-bps fax	2,400-/9,600-bps fax	2,400-/9,600-bps fax	14,400-/9,600-bps fax
Sharp	Sharp	Sanyo	Toshiba	DTI	Info not available	Info not available	Sharp	Sharp
Cirrus	Cirrus	Cirrus	Toshiba	Toshiba	WD	WD	Cirrus	Cirrus
□	□	□	□	□	□	□	□	□
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
gray shades	64 gray shades	256 colors	256 colors	256 colors	64 gray shades	256 colors	256 colors	256 colors
800 x 600	1,024 x 768	1,024 x 768	640 x 480	640 x 480	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
256	16	16	256	256	16	16	16	16
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
5 x 6 x 2.3	1.5 x 2.3 x 6	1.6 x 6 x 2.3	1.5 x 5.8 x 2.8	1.8 x 6.3 x 3	1.3 x 5.8 x 3	1.3 x 3 x 6	1.5 x 6 x 2.8	1.5 x 6 x 2.8
4.5	4	3.5	2	3	3	2.5	2.5	2.5
5:21, 3:05	7:02, 4:18	3:44, 2:16	3:47, 2:03	4:36, 2:22	6:17, 3:58	4:19, 1:50	1:54, 1:36	2:30, 2:03
3, 3	3, 3	3, 3	2, 1.3	1.5, 1.5	4, 2	4, 2	4, 2	4, 2
3.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah	1.6 lbs, 2.8Ah	2.4 lbs, 2.4Ah	1.4 lbs, 2.4Ah	1.5 lbs, 3.3Ah	1.5 lbs, 2.3Ah	1.5 lbs, 1.7Ah
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
6.0, 3.1	6.0, 3.1	6.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1	5.0, 3.1
1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
\$129	\$129	\$129	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
A92486DX2	A32148625	A92486SXC	CJ6UN186	CJ6UN186	CJ6UN452	CJ6UN453	FKGSNTFT488	FKGSNTFT-486

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CIRCLE 342 ON READER SERVICE CARD

COVER STORY
Portable PCs

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order by company							
■ = YES □ = NO							
	Twinhead Slimnote 4SX/33M	ZDS Z-Lite 320L	ZDS Z-Note 425Ln Model 120	ZDS Z-Note 425Lnc Model 200	ZDS Z-Note 425Lnp Model 120	ZDS Z-Sport 420S	
List price (tested configuration)	\$1,849	\$1,999	\$2,878	\$4,278	\$3,278	\$1,798	
Processor type and speed	Intel 486SX/33	Intel 386SL/20	Intel 486SL/25	Intel 486SL/25	Intel 486SL/25	Intel 487SX/20	
Hard disk capacity	130MB	61MB	121MB	200MB	121MB	85MB	
Dealers/Direct-distribution channel	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
Dimensions (HWD, in inches)	1.5 x 11 x 8.5	1.3 x 10 x 7.5	2.3 x 11.5 x 8.5	2.3 x 11.5 x 8.5	2.3 x 11.5 x 8.5	2 x 11 x 8.5	
System weight/travel weight (pounds)	6.1, 7.8	4, 5.1	5.8, 7.3	6.6, 8.1	6.5, 8	6, 7.8	
Display area and diagonal (inches)	5.8 x 7.5 x 9.5	5.3 x 6.8 x 8.5	5.8 x 7.8 x 9.5	5.3 x 6.8 x 8.5	5.8 x 7.8 x 9.5	5.8 x 7.8 x 9.5	
Keys: total, function, cursor	84, 10, 8	83, 12, 8	82, 12, 8	82, 12, 8	82, 12, 8	87, 12, 8	
Type of pointing device installed	Built-in	Snap-on	Clip-on	Clip-on	Clip-on	None	
Motherboard							
Motherboard manufacturer	Twinhead	ZDS	ZDS	ZDS	ZDS	ZDS	
Chip set manufacturer	ACC/Twinhead	Intel	Intel	Intel	Intel	Intel	
BIOS version (or date)	Phoenix (2/15/93)	ZDS (3/26/93)	ZDS 4.01	ZDS 4.01	ZDS 4.01	Phoenix (4/19/90)	
Setup in ROM/Password in ROM	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	□ □	
Memory and Disk Drives							
Installable RAM	4MB-20MB	2MB-10MB	4MB-28MB	4MB-28MB	4MB-28MB	4MB-12MB	
User-installable	■	■	■	■	■	■	
External processor RAM cache	None	None	None	None	None	None	
Available hard disk sizes	130MB-200MB	61MB	120MB-200MB	200MB	120MB-200MB	85MB	
I/O and Expansion							
Parallel, serial, mouse, expansion ports	1, 1, 1, 1	1, 1, 1, 0	1, 1, 0, 1	1, 1, 0, 1	1, 1, 0, 1	1, 1, 0, 1	
High-speed parallel/serial support	□ □	■ □	□ ■	□ ■	□ ■	■ □	
Ports for port replicator/expansion chassis	□ ■	□ □	■ □	■ □	■ □	□ ■	
PCMCIA slots	None	Two Type I, two Type II	None	None	None	None	
Internal modem installed	2,400-/9,600-bps fax	None	None	None	None	None	
Video							
Screen manufacturer	Sharp	Info not available	Info not available	Info not available	Info not available	Info not available	
Video chip set manufacturer	Cirrus	Cirrus	C&T	C&T	C&T	Cirrus	
Simultaneous external display	■	■	■	■	■	■	
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	
Maximum internal gray shades or colors	64 gray shades	64 gray shades	64 gray shades	256 colors	256 colors	64 gray shades	
Maximum external resolution	800 x 600	640 x 480	1,024 x 768	1,024 x 768	1,024 x 768	640 x 480	
Maximum external colors	16	256	16	16	16	256	
Illuminated screen/Active matrix	■ □	■ □	■ □	■ ■	■ □	■ □	
AC Adapter and Battery							
AC adapter size (inches)	1.8 x 6.5 x 3	1.5 x 5.3 x 2.5	1.6 x 6 x 2.8	1.6 x 6 x 2.8	1.6 x 6 x 2.8	2 x 7 x 3	
Rated battery life (hours)	2.5	3	4.3	2.5	4.3	2	
ZDigit Rundown, Battery Rundown (hr:min)	3:05, 2:03	4:02, 3:31	8:33, 4:23	4:17, 2:39	5:01, 2:37	4:02, 2:49	
Charge time while on, off (hours)	1.5, 1.5	10, 2.5	8, 2.3	8, 2.3	8, 2.3	3.5, 1.5	
Battery weight, amp/hour rating	1.3 lbs, 1.7Ah	0.9 lbs, 2.3Ah	1.2 lbs, 2.3Ah	1.3 lbs, 2.2Ah	1.3 lbs, 2.3Ah	1 lbs, 2.2Ah	
Display/hard disk power-down	□ ■	■ ■	■ ■	■ ■	■ ■	■ ■	
CPU/peripherals power-down	■ ■	■ □	□ □	□ □	□ □	■ □	
Standby/Hibernation	■ □	■ ■	■ ■	■ ■	■ ■	□ ■	
Miscellaneous							
DOS version, Microsoft Windows version	5.0, 3.1	5.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	5.0, None	
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	
First year on-site service charge	N/A*	Varies	Varies	Varies	Varies	Varies	
FCC Class B identification number	FKGSLIMNOTE-486	IFO-L386SL	IFO-486SL25	IFO-486SL25	IFO-486SL25	BEJGS48SIN20L	

N/A* - Not applicable. The product does not have this feature. NA** - Not applicable. The product could not perform this test. ACC - ACC Micro Electronics Inc. AES - Area Electronics Systems Inc. C&T - Chips & Technologies Inc., DTI - Display Technologies Inc., FI - First International Computer Corp., TI - Texas Instruments Inc., VLSI - VLSI Technology Inc., WD - Western Digital.

ENDS

ZDS Z-Sport 425S	Zeos Contenda
------------------	---------------

\$2,098	\$1,894
Intel 487SX/25	Intel 386SL/25
121MB	80MB
■ ■	□ ■
2 x 11 x 8.5	1.8 x 9.7 x 6.1
6, 7.7	4.1, 5.1
5.8 x 7.8 x 9.5	4.5 x 6 x 7.5
87, 12, 8	80, 12, 4
None	Built-in

ZDS	Zeos
Intel	Intel
Phoenix 1.01	Phoenix (2/23/93)
■ ■	■ ■
□ □	■ ■

4MB-12MB	2MB-10MB
■	□
None	None
120MB	80MB

1, 1, 0, 1	1, 1, 0, 1
■ □	■ □
□ ■	□ □
None	None
None	2,400-9,600-bps fax

Info not available	Sharp
Cirrus	Cirrus
■	■
640 x 480	640 x 480
64 gray shades	64 gray shades
640 x 480	800 x 600
256	16
■ □	□ □

2 x 7 x 3	1.5 x 3 x 4.5
2	3.5
N/A*, 2:49	2:52, 2:38
3.5, 1.5	5, 1.3
1 lbs, 2.2Ah	1 lbs, 2.2Ah
■ ■	■ ■
■ □	■ ■
□ ■	■ □

5.0, None	6.0, 3.1
1 year	1 year
Varies	N/A*
BEJGS48SIN25L	HFSPK3

Microsoft Windows Applications test results put them solidly in the top 15 percent, and their overall applications scores were top-notch as well.

The three systems placed near the very top on both the processor and memory tests. They had the second-best DOS and Windows hard disk scores, thanks to the Toshiba MK-2224FC hard disk with a 128K cache and an average access time of 12 milliseconds.

The video test scores were more mixed. On the DOS video tests, the three scored only slightly better than average. But on the Windows graphics tests, they placed in the top 15 percent.

The Twinhead 4SX/33M, the only SX/33 in this roundup, performed well in some areas, but had a more inconsistent



FACT FILE

Compydyne 4DX2/66 Monochrome Slimnote

Compydyne 4DX2/66 Active TFT Color Slimnote

Compydyne, 15167 Business Ave., Dallas, TX 75244; 800-862-3099, 214-702-0055; fax, 214-888-5743

List price: Monochrome Slimnote, \$2,999; Color Slimnote, \$4,499.

Tested configuration: 4MB 70-ns RAM, 213MB Toshiba MK2224FC IDE hard disk with 128K cache, 1.44MB floppy disk drive, DOS 6.0, Microsoft Windows 3.1, Lotus Orgaziner 1.0, built-in trackball.

Options: 4MB RAM upgrade, \$229; 16MB RAM upgrade, \$1,700; extra nickel hydride battery, \$139; 2,400-/9,600-bps data/fax modem, \$199; external 1.44MB floppy disk drive, \$149; external numeric keypad, \$69.

In short: Thin, lightweight, and powerful, the Compydyne 4DX2/66 Monochrome Slimnote and its color cousin both had respectable battery times for a power portable.



Compydyne 4DX2/66 Monochrome Slimnote

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	EXCELLENT
Windows applications	GOOD
Desktop replacement	GOOD

VENDOR SERVICE & RELIABILITY

Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

set of scores overall. It features the Cirrus Logic GD6410 video chip set rather than the GD6420 used in all the other models. The GD6410 supports 256K of VRAM rather than 512K.

The Twinhead 4SX/33M Slimnote also has a smaller, slower hard disk: the Toshiba 130MB MK2124FC, with an average access time of 17 ms. So,

while this machine came in just behind the Twinhead 4DX/33T on the processor, memory and Windows Application tests, its DOS disk and video scores were average to below average for the entire test group; its DOSmark score was just above average. Its Windows test scores kept it in the top third of all tested machines.

The Sharp TFT screen used on the color models produces excellent text and graphics. Characters have sharp edges and a crisp look; color is true and evenly saturated. Screen brightness can be adjusted so you will not see an echo or any other distortion. The Sharp screen compares quite well with a VGA desktop color monitor.

The Sharp monochrome screen on one of the Twinheads and on one Compydyne is another story. The screen produces a fair amount of image echo, though the characters and images look well de-

Twinhead Slimnote 4SX/33M

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	GOOD
Windows application	GOOD
Desktop replacement	TK

Twinhead Slimnote 4DX/33T

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD

**"It's a quality desktop replacement...
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One of the lightest units in the entire test group."**

— PC Magazine, Mar. '93

**"...in our battery tests, the TI 4000 WinDX2/50
achieved a magnificent 6 hours and 24 minutes."**

— Portable Computing, Apr./May '93

**"TI has done more to customize and optimize
Windows than the other notebook vendors."**

— Windows Magazine, Feb. '93



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Battery life varies according to model and use



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CIRCLE 304 ON READER SERVICE CARD

fined. Also, the brightness is quite uneven. The lower third of the screen and the sides get overly bright, making images look washed out.

The units' two different cases—a slightly thicker version for the active TFT models—are well designed. You'll find the on/off switch and a trackball conveniently located just above the keyboard. Near the trackball is a suspend switch and a panel of eight LED indicator lights for the keyboard and system. The 84-key keyboard has standard spacing and a good, responsive feel.

FACT FILE

Twinhead Slimnote 4SX/33M

Twinhead Slimnote 4DX/33T

Twinhead Slimnote 4DX2/66T

Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; 800-995-8946, 408-945-0808; fax, 408-945-1080

List price: Slimnote 4SX/33M, \$1,849; Slimnote 4DX/33T, \$3,899; Slimnote 4DX2/66T, \$4,499.



The Twinhead Slimnote 4SX/33M, Slimnote 4DX/33T, and Slimnote 4DX2/66T

Tested configuration: 4MB 70-ns RAM, 130MB Toshiba MK-2124FC hard disk with a 32KB buffer (4SX/33M), Toshiba MK2224FC IDE hard disk with 128K cache (4DX/33T, 4DX2/66T), 1.44MB floppy disk drive, 2,400-/9,600-bps data/fax modem (4SX/33M, 4DX/33T), 14,400-/9,600-bps data/fax modem (4DX2/66T), DOS 5.0, Microsoft Windows 3.1, built-in trackball.

Options: 4MB RAM upgrade, \$250; 16MB RAM upgrade, \$1,399; mouse, \$69; expansion box, \$399; extra nickel cadmium battery, \$80; extra nickel hydride battery, \$125; 14,400-/9,600-bps data/fax modem, \$350.

In short: The Slimnote 4SX/33M offered some bright spots but was inconsistent. The Slimnote DX/33T and 4DX2/66T offered small, light, but powerful packages.

ON READER SERVICE CARD

A 1.44MB floppy disk drive is on the right side toward the front. At the back you'll find an expansion slot, external keyboard and monitor connectors (simultaneous use of a CRT is supported), and the I/O ports. A battery easily slips in and out of a compartment underneath the unit.

The two battery types used—nickel cadmium for the two monochrome units; nickel hydride for the color models—had varied ZDigit Rundown scores, ranging from 1 hour 36 minutes for the Compu-dyne Color (the shortest time of all systems in this roundup) to 3 hours 5 minutes for the monochrome Twinhead 4DX/33T, which placed it in the top third. Battery Rundown times also ran the gamut from the Twinhead 4DX/33T, which was in the bottom 15 percent overall, to the Compu-dyne Monochrome, which lasted 2 hours 48 minutes.

Twinhead Slimnote 4DX2/66T

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **EXCELLENT**

Windows applications **GOOD**

Desktop replacement **EXCELLENT**

You can easily install a fax/modem and additional memory in a compartment above the keyboard on the left.

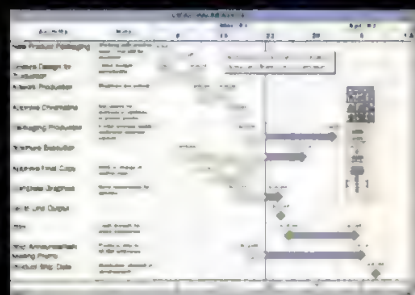
You can upgrade to 20MB of RAM with a 16MB SIMM (\$1,400 for the Twinhead, \$1,600

for the Compu-dyne). In the DX2/66 models you'll find several features to lower the heat: a temperature-controlled fan, a heat sink, and an Intelligent Power Management chip that slows down the processor when the data bus is idle.

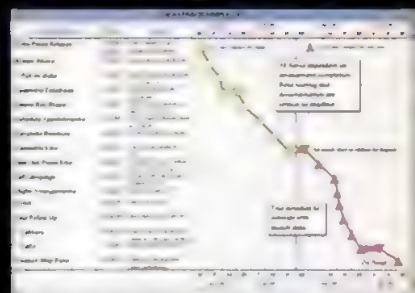
Each of the Twinhead and Compu-dyne models would make an excellent traveling companion. Choosing between them is a matter of price and service.

The Twinhead 4DX2/66T has the advantage with a very fast 14,400-/9,600-bps data/fax modem included in its price. One nice feature Compu-dyne offers is a one-day replacement service for an extra \$99 per year.—Henry Fersko-Weiss

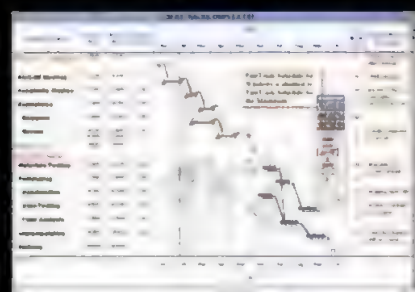
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Zenith Data Systems

ZDS Z-Note 425Ln Model 120

ZDS Z-Note 425Lnp Model 120

ZDS Z-Note 425Lnc Model 200

All three of these Z-Notes from Zenith Data Systems (ZDS) have built-in Ethernet connections, good displays, reasonable prices, and above-average performance. The units are all based on the same 25-MHz Intel 486SL chip (microprocessors are not upgradable). The systems come with 4MB of RAM (expandable to 28MB) and have no external cache. The Z-Notes range in price from \$2,878 to \$4,278.

What sets them apart from one other is the type of display. The \$2,878 ZDS Z-Note 425Ln Model 120 is equipped with a monochrome display. The slightly more expensive model, the \$3,278 ZDS Z-Note 425Lnp Model 120, has an above-average passive-matrix color LCD and

the \$4,278 ZDS Z-Note 425Lnc Model 200 has an active-matrix color display.

With a measurement of 8.4 inches diagonally, the screen of the 425Lnc is a little smaller than some of the competition, but it does produce sharper and more brilliant color than the 425Lnp passive-matrix model. However, when compared with the competition, the 425Lnc's display lacks the brightness of similar active-matrix screens. The unit does come equipped with a 200MB hard disk instead of the 121MB units found in the 425Ln and 425Lnp.

The Z-Notes come standard with a spacious keyboard that does not give the

user the typical cramped feeling associated with many other notebooks. Most function keys are full-size and clearly marked, and the keyboard's audible click can be turned off. These units, however, lack some of the full-travel feel found on other portables in this roundup.

All three models allow you to use the LCD and an external monitor (with up to 1,024-by-768 resolution) simultaneously, with 16 colors. Two text-display modes are available: The standard display leaves a blank space at the top and at the bottom of the screen, while the "stretch" mode fills the entire screen. These settings have no

ZDS Z-Note 425Ln Model 120

SUITABILITY TO TASK

Road warrior	EXCELLENT
DOS applications	GOOD
Windows applications	FAIR
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

ZDS Z-Note 425Lnp Model 120

SUITABILITY TO TASK

Road warrior	GOOD
DOS applications	FAIR
Windows applications	FAIR
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

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This foldout contains a summary of the information you're likely to need while traveling: modem commands, electronic service phone numbers and command summaries, international voltage information, and more.

GETTING READY FOR THE ROAD

Before you travel, go through these steps:

Tape business cards to the bottoms of your laptop, transformer, portable modem, and portable printer. Should you leave something in a hotel, it's more likely to be returned if it has this identification. Also add these ECHOed or REMed lines at the bottom of your AUTOEXEC.BAT file: "ECHO If Found Please Contact <Enter> ECHO your name and phone number <Enter> ECHO Reward <Enter>".

Make and carry a bootable DOS floppy disk for use in case you damage one of the startup files and your laptop can't boot itself. Also consider carrying floppy disk copies of key applications.

Make sure you have all your hardware: mouse or portable trackball, transformer, transformer-to-AC outlet plug, spare battery, extra floppy disks, file-transfer cable, printer cable, spare 9- or 1.5-volt batteries for external modems.

Make a list of any special commands you need to operate your laptop (how to turn on the modem or external video) if your laptop doesn't have a carry-along compact reference guide.

Make a list of personal dial-up phone numbers and passwords for your office LAN's dial-in connection and the local BBSs you use on the road. Also include technical support numbers for your laptop and software vendors, and serial numbers for all software.

Carry these tools and accessories:

- RJ-11 phone cable. A must-have (don't buy the handset cord cable, which looks the same but doesn't fit).
- Small flat-bladed and Phillips-head screwdrivers and needle-nose pliers.
- Miniature flashlight.
- In-line phone cord coupler (to make one long phone cord out of two shorter cords)
- Modular duplex phone jack, a plug-in Y connector that gives you two phone jacks in place of one (this can also be used as an in-line coupler).
- Modular-to-spade-lug line: A standard RJ-11 or RJ-14 phone plug at one end, four color-coded wires at the other. Attach small alligator clips to the red and green wires, and use this to make direct connections to the phone if no wall or phone jack is accessible. Connect the red and green wires to the red and green wires at the wiring block (wall outlet) or to the two contacts on the phone mouthpiece.
- International line-cord power plug adapter and international telephone adapter (RJ-11-to-PTT adapter); available through electronics supply shops in large cities, or contact your laptop maker.
- Three-prong-to-two-prong plug adapter.

TRAVEL TIPS

Consider joining an airline travelers' club (such as Admirals or Red Carpet)—\$75 to \$200 yearly—for airport access to RJ-11 phone jacks, AC power connections, and in some cases computers.

To stretch your battery, turn the CPU to slow, turn down the display intensity, power-down the serial and parallel ports, don't use the hard disk (let it spin down), and do use a disk

cache (to keep from accessing the hard disk).

Set up your laptop software for LCD (preferred) or monochrome display, not color, not black-and-white. Choosing "color" may give you a combination you can't read.

Rather than carrying a printer, send yourself a fax at your hotel using an e-mail service or a fax modem.

Some battery-powered external modems remain on (drawing power) whenever connected to the PC. Turn your modem off or disconnect it.

"Call waiting" knocks your modem off the line. To cancel the feature for one phone call, add "*70" (sometimes "#70") at the beginning of the dialing string.

Useful phone numbers: Naval Observatory Clock (exact time—voice), 900-410-8463; NIST Clock (exact time—modem), 303-494-4774.

MAKING PHONE CONNECTIONS

Connect your computer to the phone system (as in a hotel) in one of these ways (listed in order of increasing difficulty). Below, "your laptop" means the RJ-11 phone cord from your modem; "wall outlet" means the phone outlet, not the AC outlet. Some phones are hard-wired (with no modular connector) at one end but not the other.

- Plug your laptop into the data port on the telephone.
- Unplug the telephone and plug the phone cord into your modem jack.
- Unplug the telephone at the wall outlet; plug your laptop into the wall outlet.
- If your modem has two jacks and you want the phone to remain usable, unplug the phone at the wall outlet. Plug the phone into the modem. Plug the modem into the wall outlet.
- If you want the phone to remain connected and you have only one modem jack, plug a modular duplex connector (Y connector) into the wall outlet. Plug both the phone and your laptop into the Y connector.
- If the phone cord disappears into the wall behind a wall plate, undo the two screws on the wall plate. There may be a modular jack inside.
- If there's no modular jack behind the wall plate but you can see a wiring block with red and green connectors, use a modular-to-spade-lug connector (with alligator clips on the red and green lug ends). Connect the red and green alligator clips to the wiring block's red and green wires; connect the RJ-11 jack to your modem. You then can dial as usual. (Caution: Phone line voltage is minimal except when the phone is ringing.)
- Undo the mouthpiece on the telephone, exposing two silver contacts. Connect the modular-to-spade-lug connectors to the contacts; connect the other end to your laptop. Take the handset off the hook just before you dial, and leave it off until your communication session finishes.
- If there's a bathroom phone, it may slide off, exposing an RJ-11 jack. (You may have to start by manipulating a locking lever on one side of the phone.)
- Use a handset coupler. Unplug the handset. Plug the handset coupler into the phone. Plug the handset and your laptop RJ-11 cord into the handset coupler. (The two plugs look similar but

are different; you'll find that handset jacks are more often standardized than are RJ-11 wall plugs.) This also works with digital phones.

- Use an acoustic coupler connected to the handset. Good couplers can handle 2,400 bps, and possibly 9,600 bps on good lines.
- Use the hotel business center.
- Ask the hotel to unplug its fax machine temporarily. Any line a fax machine uses will work for your modem. If the day-shift staff says no, ask again in the evening.

Note: Hotels sometimes break off the tip of the locking lever on the phone's RJ-11 cord as a rudimentary security measure. Use a small pocketknife or flat-blade screwdriver to release the RJ-11 plug.

HAYES-COMPATIBLE MODEM COMMANDS

Most modems are Hayes-compatible and use the Hayes commands. Commands begin with "AT" (for "attention, modem") and end with a Return (<Enter>). Exceptions: "A" (repeat last command) and "+++" (escape sequence, interrupt modem) don't use "AT" or <Enter>.

If you're stringing commands together, you need the "AT" only before the first command. Extra spaces and most punctuation (such as hyphens in phone numbers) are ignored. Capitalization usually doesn't matter ("AT" = "at"). Modems can't dial vanity numbers ("800-BIG-GULP"). Transcribe command strings carefully; don't confuse 0 (zero) with O (oh) or 1 (one) with l (ell).

Command	Description
AT	Attention, modem, a command follows
ATA	Answer the phone
AT	Attention, modem, a command follows
ATDT	Dial using tone dialing
ATDP	Dial using pulse dialing
ATH	Hang up the phone
A/	Repeat last command. This command does not begin with "AT" or end with <Enter>
ATS0=2	Answer after <i>n</i> rings (here, 2 rings)
ATS0=0	Turn off auto-answer
ATX00	Force connection, when manually dialing, after remote modem answers
ATZ	Reset (zap) the modem
(comma)	Pause 2 seconds
+++	Escape sequence, interrupts modem when on line. Type "+++" quickly and wait for modem to respond "OK"
<Enter>	Ends command. On a line by itself, while the modem is dialing or waiting for a connection, terminates dialing

Example: "ATDT 9,1-202-456-1414<Enter>" tone-dials an outside line, pauses 2 seconds, then dials the White House. The modem ignores the space after "ATDT" and the hyphens in the phone number.

ELECTRONIC MAIL AND BULLETIN BOARDS

Here are basic instructions for major on-line services. Logging on may be more complicated from Canada or overseas. Check with the service of interest before you leave, and don't wait until the weekend or after business hours.

through the proprietary software in the Prodigy starter kit. If you want to use Prodigy right away, go to a computer or software store and buy the starter kit. Virtually all the help you'll need is in the Prodigy software; phone numbers are in the manual.

To use Prodigy, follow the instructions on-screen. There are five categories: Information, Living, Shopping, Finance, and Travel. Type "G" (for Guide) or press F5 to see where you are. Use the Tab key or a mouse to move around the screen, and press Enter or click the left mouse button to make a selection. You can also type plain-English commands at the bottom of the screen.

Command or number	Description
800/776-3449	Call for information and sign-up (voice).
800/284-5933	Call customer service and find local phone number (voice).
G or F5	View where-am-I guide.
Tab	Choose a command or option.
Enter	Execute a command.
JUMP, J, or F6	Jump (go) to another area.
I or F7	View alphabetical index.
MENU	View previous menu.
BACK or PgUp	View previous screen.
NEXT or PgDn	View next screen.
REVIEW	View list of last 12 features accessed.

INTERNATIONAL VOLTAGE AND OUTLET PLUG GUIDE

To use your laptop overseas, you will probably need an adapter plug and a transformer. There are five basic adapter plug types that cover most of the world, and they are illustrated below. These five plugs, labeled A, B, C, D, and E, correspond to the chart that follows.

Modern laptops are already fairly self-sufficient in handling foreign power sources. Most of the world uses 220-volt AC, while the U.S., Canada, and much of Central and South America use 110-volt AC. Most laptops are generally dual-voltage, meaning that their internal or external transformers automatically adapt to any voltage from 100 to 260. Also, although power overseas may be 50 Hz instead of the 60 Hz common in North America, most dual-voltage transformers operate at 50 and 60 Hz. However, a few countries use direct current (DC). If you encounter that situation, you'll need a DC-to-AC converter.

Don't use a converter to power a computer. Use a transformer instead, or buy a product that works with both voltages. How do you know if you have a transformer or a power converter? A transformer weighs several pounds, a converter weighs just a few ounces. And don't use the 110-volt outlet marked "Shaver" or "Razor" in nondomestic hotel bathrooms unless you have specific assurance from the hotel staff that it's O.K. for computers.

Following is an illustration of the five plug types and a chart that shows the voltages and outlet plug types used in foreign countries. A comprehensive database on international voltage and plugs is maintained by Franzus Co. Inc., Murtha Industrial Park, Beacon Falls, CT 06403, 203-723-6664, fax, 203-723-6666.

Sources: *PC Magazine Guide to Notebook and Laptop Computers*, by Bill Howard, and *PC Magazine DOS 5 Techniques and Utilities*, by Jeff Prosser, both from Ziff-Davis Press. Additional research by Franzus Co. and *PC Magazine*. Compiled by Carol Venezia.

International Voltage And Outlet Plug Guide

Country or region	Voltages available		Plug types
	110V	220V	
Afghanistan		●	B
Algeria	●	●	A B D
Angola		●	B
Antigua		●	D E
Argentina *		●	D E
Aruba	●		A
Australia		●	C
Azores	●	●	A B
Bahamas	●		A
Bahrain		●	D E
Bangladesh		●	B
Barbados	●		A
Belgium	●	●	A B
Belize	●	●	A
Bermuda	●		A
Bolivia	●	●	A B
Botswana		●	D E
Brazil *	●	●	A B C D E
Bulgaria		●	B
Burkina Faso		●	B
Burma		●	D E
Burundi		●	B
Cameroon	●	●	A B
Canada	●		A
Central African Republic		●	B
Chad		●	B
Chile		●	B
China		●	B C E
Colombia	●		A
Costa Rica		●	A
Cyprus		●	D E
Former Czechoslovakia		●	B
Denmark		●	B
Dominican Republic	●		A
Ecuador	●		A
Egypt		●	B
El Salvador	●		A
Ethiopia		●	B
Finland		●	C
Finland		●	B
France		●	B
French Guiana		●	B
Gambia		●	D E
Germany		●	B
Ghana		●	B D E
Gibraltar		●	D E
Greece		●	B
Greenland		●	B
Grenada		●	B D E
Guatemala	●		A
Guinea		●	B
Guyana	●		A B D E
Haiti	●		A
Honduras	●		A
Hong Kong		●	D E
Hungary		●	B
Iceland		●	B
India *		●	B D E
Indonesia	●	●	A B E
Iran		●	B
Iraq		●	B
Ireland		●	D E
Israel		●	B

Italy			B
Ivory Coast			B
Jamaica			A
Japan			A
Jordan			B
Kenya			D E
Korea			A B
Kuwait			B D E
Laos			B
Lebanon			B
Liberia			A
Libya			B
Luxembourg			B
Malawi			B
Malaysia *			B
Malawi			B
Malawi			D
Malaysia			D
Malta			D E
Martinique			B
Mexico			A
Nepal			B E
Netherlands			B
Netherlands Antilles			A B D E
New Caledonia and New Zealand			C
Nicaragua			A
Niger			B
Nigeria			D E
Norway			B
Oman			D E
Pakistan			B
Panama			A
Paraguay			B
Peru			A B
Philippines			A B
Poland			B
Portugal			B
Porto Rico			A
Qatar			D E
Romania			B
St. Lucia			D E
Saudi Arabia			A B C D E
Senegal			B
Switzerland			C E
Sierra Leone			D E
South Africa *			D E
Spain			A B
Sri Lanka			E
Sweden			B
Suriname			D E
Swaziland			B
Sweden			B
Switzerland			B
Syria			B
Tahiti			A
Taiwan			A
Tanzania			D E
Thailand			A B
Timor			A B C E
Togo			B
Tunisia			B
Turkey			B
Turks and Caicos Islands			A
Uganda			D
United Kingdom			D E
Uruguay			D E
U.S.A.			A
Former U.S.S.R.			B
U.S. Virgin Islands			A
Venezuela			A
Vietnam			A B
Yemen			A B
Former Yugoslavia			B
Zaire			B
Zambia			D E
Zimbabwe			D E

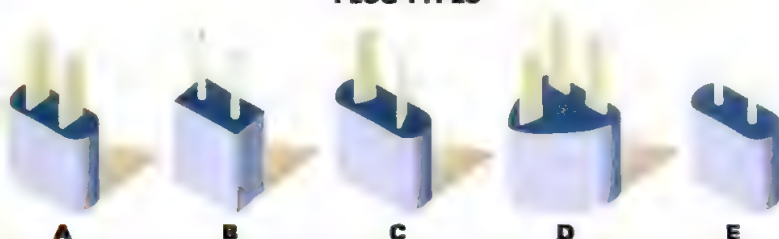
* This country uses C in some areas.

110 volts means 100-160 volts alternating current (AC).

220 volts means 200-260 volts.

Source: Franzus Co. Inc.

PLUG TYPES



1. Follow instructions on the other side

Back

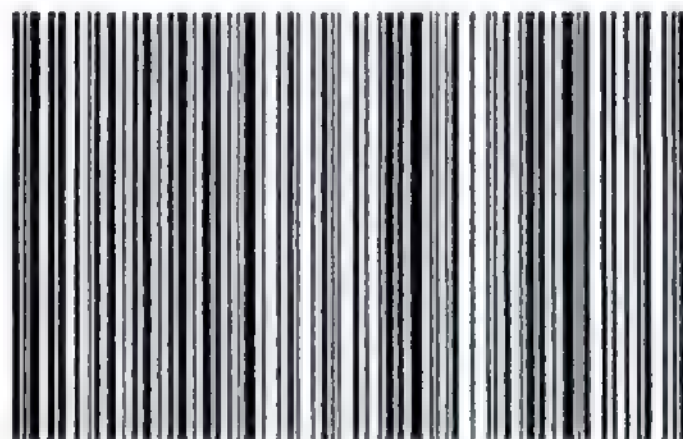
Gbs5lipBack-0018



Inverted Back

1. Follow instructions on the other side

Folded edge of the page



Inverted Foldout slip-sheet

Foldout slip-sheet

1. Open the foldout page

2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



1. Open the foldout page

2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



CompuServe Command Basics

Many commands can be abbreviated to one, two, or three characters. You can enter them at any CompuServe prompt, the most frequent prompt being the exclamation point (!). If you don't wish to learn the commands, simply enable the Menu option (the default) and move through them. You can type HELP at any prompt.

Command	Description
M	MENU (previous)
T	Go to TOP of menu page
F	FORWARD a page
B	BACK a page
H	HELP
R	RESEND
SN	SCROLL output
GN	GO to page n
N	NEXT menu selection
P	PREVIOUS menu select on
HELLO	Log on again
END, OFF, BYE	Hang up (end the session)
EXIT	Exit a forum (don't hang up)
Ctrl-C	Interrupt display, go to prompt
Ctrl-S	Pause display of information
Ctrl-Q	Resume display of information

The GO command bypasses the menu structure. If you know where you want to go, GO is faster. Type "GO" and the name of the area you want to access. "GO IBMSW", for example, takes you to the IBM-compatible software forum. To find an area of interest, enter "FIND" and a topic name.

GO Command	Description
GO BILLING	Review your bill or change address
GO COMMANDS	View summary of commands
GO FEEDBACK	Ask a question or complain
GO HELP	View help and instructions
GO LOGON	Review log-on procedures
GO PHONES	Find local access numbers
GO PASSWORD	Change your password
GO PROFILE	Change display of service options
GO RATES	View rate information
GO DIRECTORY	Find a member by address
GO PRACTICE	Free practice

AT&T Mail

Accessing AT&T Mail

For accessing AT&T Mail, AT&T offers its proprietary software, Access PLUS, which is available in DOS and Windows versions for list prices of \$150 and \$210, respectively. Access PLUS is usually subject to significant promotional discounts.

For those who elect not to use the company's product, accessing the service directly carries a surcharge. Users who access in terminal mode are subject to a surcharge of 20 cents per thousand characters (or a fraction thereof) on originated messages of up to 3,000 characters, and 10 cents per thousand characters (or fraction thereof) after that.

AT&T Mail Phone Numbers and Parameters

For AT&T Mail access in Canada, call customer service for the local-access number or use the Toronto toll number. Overseas, use the Bridgeton toll number.

Number	Description
800-624-5123	800 access (1,200 or 2,400 bps)
416-502-3000	Toronto, Canada
314-770-3800	Bridgeton, Missouri
800-624-5672	24-hour voice help
800-667-4071	24-hour voice help in Canada
Comm settings	8 data bits, no parity, 1 stop bit (8-N-1)

5,600 bps MNP 5 and 9,600 bps CCITT V.42-1, 42bis access are available to selected users on an as-needed basis.

AT&T Mail Basic Commands

Command	Description
ANSWER	Reply to sender of a message
COPY INTO	Copy a message into a named folder
CREATE	Write a message
DELETE	Delete a message
DIRECTORY	Search for an AT&T Mail customer
DOWNLOAD	Download a message from the current folder
EDIT	Make changes to a message on your desk
FORWARD	Forward a message to another account
GET	Retrieve a message from the wastebasket
MOVE INTO	Move a message into a named folder
OPEN	Open a folder
PRINT	Display a message without pausing at the end of each screen
PROFILE	Display account information or modify options
QUIT	Exit AT&T Mail and empty the wastebasket
READ	Read a message
REDELIVER	Resend a message
RENAME	Change list or folder name
SEND	Send a message
SUBSCRIBE TO	Subscribe to a shared folder
SHARE LIST	Share an address list with other AT&T Mail subscribers
SHOW	List messages on desk
STORAGE	Display statistics on messages and mailing lists
UPLOAD	Upload message text to desk
VIEW	Read messages and show envelope lines

To send a message to AT&T subscribers through Internet, you should address the message to "AT&T Mail user name@ATTMAIL.COM".

To send a text fax from AT&T Mail, in the recipient field enter "FAX fax number".

Genie

Genie (the on-line service of General Electric Information Services) is smaller and cheaper than CompuServe or Prodigy, especially during off-hours.

800-638-2222	Information/sign-up (voice)
800-638-8369	Information/sign-up (modem)
Comm settings	8 data bits, no parity, 1 stop bit (8-N-1)

This is the initial log-on procedure: Dial the 800 access number. Use local echo (set your software to half duplex). When you connect, press Enter, type "HHH" and press Enter, and type "SIGNUP" and press Enter. Follow the prompts.

OFFICIAL AIRLINE GUIDE

The Official Airline Guide (OAG) provides schedules and reservations for 600 airlines and major hotels. Typically, you access OAG through another service. From CompuServe, type "GO OAG" and Enter. From MCI Mail, type "DOWJONES" and press Enter, then type "//OAG" and press Enter.

800-323-4000	Customer service/help
01-930-2915	Customer service/help (Europe)

Here are the OAG commands:

Command	Description
/S	View airline schedule information
/F	View airline fare information
/C	Cancel a reservation
/H	View hotel/lodging information
/I	Call up on-line information (help)
B	Reserve (book) a flight
X	View expanded hotel/lodging information
MM	Return to OAG main menu
OFF	Leave OAG, return to primary service
/S From, ToDate	Quick schedule query format
SLAX, NYC12APR6A	Sample schedule query

OAG normally steps you through a query one question at a time. Save time by entering one-line queries. Type (with no

spaces) "/S" for schedule information, then the city or airport you're leaving from, a semicolon, the city or airport you're flying to, the date and month (in DDMMM format), and then the earliest time you want to leave (for instance, 6A, 10:30A, 1:45P, 1930). Then press Enter. For fares, follow this same format after the /F command.

Enter departure and arrival times in effect at the airport, not from where you're calling. Use either the city name, the airport name, or the airport code to specify the city or airport you want. The city name may cover several airports. OAG accepts several city names; for example, New York City and NYC both work.

Eaasy Sabre

The Eaasy Sabre service is run by American Airlines. It provides airline, hotel, and car rental information and reservations and is typically accessed through another communications service such as CompuServe. 800-831-2690 is the phone number for the help desk (voice).

Command	Description
Help or ?	View help (from any prompt)
Res or /R	View reservations menu
Top or /T	View main menu
Exit or /E	Exit to main on-line service
AIR FROM TO DATE, TIME CLASS	Quick entry (airline)
HOT CITY ARRIVE DEPART #GUESTS	Quick entry (hotel)
CAR CITY ARRIVE DEPART COMPANY	Quick entry (car rental)

You can follow the menu prompts to find a schedule or fare, or use a one-line quick-entry method called Fasttrack. To enter a query quickly: Type "/AIR", "/HOT", or "/CAR" for airline, hotel, or car information, respectively. Use commas to separate the parts of your query (no spaces). Type the airport code or city you're departing from, the city you're flying to, the date (in DDMMM format), the earliest acceptable departure time (followed by "A" for A.M. or "P" for P.M.), and the class of travel you want. Then press Enter. For hotel and car reservations, enter the dates of arrival and departure, followed by the number of guests or the name of the car rental company.

Eaasy Sabre has look-up tables for airline-fare classes and car rental companies. Economy class is A. If you don't know the airport or city name exactly, guess; you'll be shown a list of the closest matches.

Eaasy Sabre is not surcharged on most services, but you will need an ID number and a password. The ID number is your American AAdvantage (frequent-flier) number. If you don't have an AAdvantage number, one is issued immediately; you choose the password.

DOW JONES NEWS/RETRIEVAL

Most users access Dow Jones News/Retrieval through another service, such as MCI Mail. The access command is one of the menu items, or you can type "DOWJONES" or "GO DOWJONES". The Help phone number (voice) is 609-452-1511. Dow Jones commands are preceded by two slashes ("//").

Command	Description
//MENU	View Dow Jones menu
//DJHELP	View Dow Jones help
//(Topic) HELP	View help on a topic
//NEWS	View Dow Jones news
//DJNEWS	View Dow Jones business news
//SYMBOL	Find 3 stock ticker symbols
//CQ	Get a current stock quote
//DEFINE	View definitions of financial terms
//FYI	View customer information
//DISC	Exit Dow Jones

PRODIGY

Unlike most other services, Prodigy can be accessed only

These commands work with many services, but not always through supplemental carriers such as Tymnet:

Command	Description
Ctrl-C	Interrupt remote computer.
Ctrl-X	Delete line.
Ctrl-S	Stop scrolling display.
Ctrl-Q	Restart display (sometimes any key resumes).
Ctrl-H	Backspace and delete (sometimes Ctrl-W).

MCI MAIL

MCI Mail Phone Numbers

800 numbers are accessible from the U.S. and some parts of the Caribbean. Use toll numbers (Metro Washington, San Francisco) when calling from Canada or abroad if the local PTT (postal, telephone, and telegraph service) is a hassle. (MCI now offers local access in more than 30 countries, in addition to access via PTT.)

X.PC is an error-correcting protocol supported by Lotus Express, The Norton Commander, and other MCI Mail LAN gateway programs. MNP 5 is the Microcom Network Protocol for data compression (and error control). Do not use both simultaneously; generally, you should disable X.PC.

To contact a user of another electronic service (CompuServe, Prodigy), consider Internet. Your Internet address is "XXX-XXXX [your MCI ID number] @ MCIMAIL.COM". For details, read MCI's bulletin boards (VIEW INTERNATIONAL) or help files (HELP AT&T or HELP COMPUSEVE).

Number	Description
800-234-6245	1,200 bps.
800-456-6245	2,400 bps (MNP 5).
800-967-9600	9,600 bps (MNP 5).
703-769-0700	Metro Washington, D.C. (X.PC).
703-769-0750	Metro Washington, D.C. (MNP 5).
202-467-6667	Metro Washington, D.C. (9,600 bps).
415-543-1560	San Francisco (X.PC).
415-543-6364	San Francisco (MNP 5).
800-444-6245	Voice help (24 hours).
Comm settings	8 data bits, no parity, 1 stop bit (8-N-1).

MCI Commands

These are the basic MCI commands. Type a command, or type "HELP" and the command name for details. For on-line customer assistance, send mail to the mailbox MCI HELP

MCI command	Description
ACCOUNT	Set your MCI mailbox to fit your terminal and other custom options.
ANSWER	Reply to the sender of a message.
CREATE	Write a message.
DELETE	Delete messages in your MCI Mailbox.
EDIT	Make changes to pending messages.
EXIT	Leave MCI Mail (or END or QUIT).
FILES	View a complete listing of help files available from the command prompt.
FIND	Search for an MCI Mail subscriber's name.
FIND EM	Search for a particular LAN or gateway.
FIND NAME	Search for an MCI Mail subscriber's name.
FORWARD	Forward a message to another person.
GLOSSARY	View a reference guide to commands.
INDEX	List topics available to MCI Mail users.
INCLUDE	Insert text from other messages into yours.
NEXT	Read the next message in your in-box.
PENDING	Retrieve a pending message.
PRINT	Display messages nonstop (on-screen, not using a printer).
READ	Read messages a screen at a time.
SCAN	View a summary of your mail.
SEND	Send a message.
UPLOAD	Upload addresses from a PC onto an envelope.
/slash	Cancel command, message, or message recipient. Starting the last line of message (first character on the line); ends message.

MCI Mail in Canada (Datapac)

Dial Datapac's local number, type "." (two periods) and press Enter, type "13106" and press Enter, and type "MCIMAILUSA" and press Enter. To get Canadian access numbers, log onto MCI (before you travel to Canada) and type "HELP PHONES ONTARIO" (for example). Two 2,400-bps phone numbers are 416-979-1619 (Toronto) and 604-662-7732 (Vancouver). Or dial the California or Metro Washington toll number.

MCI Mail Fax Messages

You can send a fax from MCI Mail or mix fax and e-mail recipients. Here's a summary:

MCI prompt	Type
To:	John Doe(Fax)<Enter>
Country:	<Enter> (if U.S.A.)
Fax number:	202-456-1414<Enter>

Notes: You do have to type the area code, but don't type 1 for long distance. Don't type 9 if you're calling from a PBX (private branch exchange).

When sending faxes to Canada, parts of Mexico, or some Caribbean countries, you should use the area code but not the international dialing prefix, 011

MCI also offers a service that lets users submit messages containing both text and binary data for delivery to fax. This file-to-fax capability lets users convert data files formatted in "print file" or "image file" formats into G3 fax format for delivery. This service is available to interactive, batch, and X.400 users of MCI Mail. More printer emulations and direct image-file conversion support is anticipated for release later this year.

MCI International Access

To contact MCI from outside the U.S. or Canada, follow one of these steps: Use the U.S. toll numbers, subscribe to the country's PTT service (for details, type "VIEW INTERNATIONAL ACCESS"), or use a local access number for the country (with a surcharge of 50 cents per minute). Most numbers are 9,600-bps MNP 5.

Miscellaneous MCI Mail Tips

Every command can be abbreviated to its first two characters: SC IN instead of SCAN INBOX, for example. Capitalization doesn't matter.

To gang multiple commands on the Options line, separate them with commas.

You can find, read, or delete groups of messages by using SCAN, READ, PRINT, and DELETE, with the modifiers ALL, AFTER (date), BEFORE (date), DESK, FROM (name), INBOX, and ON (date). Examples: SCAN ALL-ON 14-DEC, READ DESK AFTER 12/14, PRINT OUTBOX BEFORE DEC 14, and SCAN DESK FROM RUTHERFORD SUBJECT "SAN JOSE"

Messages remain in your DESK for five days. Unread messages stay in your INBOX until read

If you send messages to the same persons repeatedly, CREATE LIST lets you use a shorthand "alias." For example, WCOAST could be a list of 25 people you access via a combination of MCI Mail, fax, CompuServe, and paper mail

COMPUSEVE INFORMATION SERVICE

CompuServe Phone Numbers and Parameters

Phone number	Description
800-848-4480	800 access (1,200 or 2,400 bps).
800-331-7166	800 access (9,600 bps).
800-346-3247	Find local access number (by modem).
800-848-8990	Customer service.
800-848-8199	Customer service (membership sales).
Comm settings	7 data bits, even parity, 1 stop bit, full duplex (7-E-1).

CompuServe's standard pricing plan offers access to basic services for \$8.95 a month. The hourly rates for additional ser-

vices are \$6.00 (300 bps), \$8.00 (1,200 or 2,400 bps), and \$16.00 (9,600 bps). Another pricing plan, which does not include free access to basic services, carries a \$2.50 monthly fee. The hourly rates are \$6.30 (300 bps), \$12.80 (1,200 or 2,400 bps), and \$22.80 (9,600 bps). 800 access carries a \$9 hourly surcharge; the surcharge rate varies for other access networks. For details on pricing, from the main CompuServe prompt type "CHOICES", then "RATES", then "BILLING"

Log-On Procedures

Find the appropriate local telephone number, or use an 800 access number. Set the communications parameters to 7-E-1 Dial and wait for the connection message, usually the word CONNECT or CONNECT/REL. Then follow these steps.

CompuServe Direct Access. Press Ctrl-C. When prompted, enter your user ID number and password. If the log-on didn't work and you see a prompt with the characters "UIC", press Ctrl-C and start over

Tymnet. You'll see garbled characters (or possibly "Enter your terminal identifier"). Type "A", but don't press Enter. At "Please log in:", type "CPS" and press Enter. Then type your user ID and password

Telenet. Press Enter twice. At the terminal identifier prompt, type "D1" and press Enter. At "@", type "C 614227" and press Enter. Then type your ID and password

Datapac. Type one period for 300 bps or two periods for 2,400 bps. At the next prompt, type "P 29400138" and press Enter. At the host name prompt, type "CIS" and press Enter. Then type your user ID and password

Local Phone Numbers

Call a customer service number from a Touch-tone phone and follow the prompts. Or, with a modem-equipped PC, dial 800-346-3247. Once connected, at the "Host Name" prompt, type "PHONES" and press Enter; then follow the prompts. By entering your calling number, you let CompuServe determine what to suggest as the two best local phone numbers to use.

These are phone numbers for the largest U.S. cities (all 2,400 numbers are configured for 2,400, 1,200, and 300 bps)

City	2,400 bps	9,600 bps
Anaheim, California	714-520-5231	714-563-9431
Atlanta, Georgia	404-266-7060	404-841-0576
Baltimore, Maryland	410-832-0111	410-464-2413
Boston, Massachusetts	617-482-7111	617-422-1111
Chicago, Illinois	312-693-0330	312-201-0711
Cincinnati, Ohio	513-771-8543	513-771-0592
Cleveland, Ohio	216-781-4135	216-781-7596
Dallas, Texas	214-953-0436	214-720-9183
Denver, Colorado	303-629-9145	303-595-0123
Detroit, Michigan	313-535-1122	313-535-1400
Houston, Texas	713-650-5000	713-650-5143
Kansas City, Missouri	816-472-1283	816-221-3817
Los Angeles, California	213-629-4095	213-624-3730
Memphis, Tennessee	901-323-0220	901-454-6851
Miami, Florida	305-262-1643	305-262-9325
Minneapolis, Minnesota	612-331-1111	612-339-1805
New Orleans, Louisiana	504-733-2297	504-733-3184
New York, New York	212-608-6021	212-766-2080
Newark, New Jersey	201-643-0404	201-623-5666
Philadelphia, Pennsylvania	215-563-1305	215-561-1634
Pittsburgh, Pennsylvania	412-261-4192	412-471-6417
Portland, Oregon	503-253-0114	503-238-6729
Sacramento, California	916-558-0615	916-558-0241
San Diego, California	619-593-4111	619-467-9508
San Francisco, California	415-242-1111	415-494-1111
San Jose, California	408-948-5111	408-727-8111
Seattle, Washington	206-242-5737	206-414-1111
St. Louis, Missouri	314-241-5337	314-421-5651
Washington, D.C.	202-388-3303	703-591-0461

**It sits,
lies down,
and does
back
flips.**

boy.



The UltraLite® Versa™ notebook
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"faithful companion."

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makes presentations
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- Slide-in memory cards, for upgradability from 4MB all the way to 20MB**

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- Standard 9.4" STN sidelet Super VGA monochrome screen, with 64 shades of gray
- Optional 9.45" TFT active-matrix Super VGA color screen, with wide-angle viewing and 256-color display out of a possible 226,000

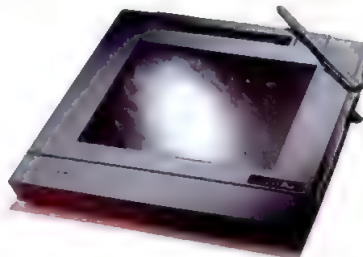
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NEC

FACT FILE

ZDS Z-Note 425Ln Model 120

ZDS Z-Note 425Lnp Model 120

ZDS Z-Note 425Lnc Model 200

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-808-4434

List price: 425Ln, \$2,878; 425Lnp, \$3,278; 425Lnc, \$4,278

Tested configuration: 4MB 70-ns RAM, 121MB Conner CP2124 IDE hard disk with 32K buffer (425Ln and 425Lnp), 200MB Seagate IDE hard disk with 64K buffer (425Lnc), 1.44MB floppy disk drive, DOS 6.0, Microsoft Windows 3.1, Microsoft Windows for Workgroups, Logitech Trackman.

Options: 4MB RAM upgrade, \$279; 8MB RAM upgrade, \$519; port replicator, \$79; extra nickel hydride battery, \$149; Ethernet LAN adapter (thin, twisted cable, or 10BaseT), \$69; numeric keypad, \$69; battery charger, \$59; worldwide power adapter, \$109.



The ZDS Z-Note 425Ln Model 120, 425Lnp Model 120, and 425Lnc Model 200

In short: These three Z-Note portables are solid performers that are network-ready and reasonably priced, setting them apart from the competition. The machines turned in above-average scores on most benchmark tests and received impressive Battery Rundown test scores. While the Z-Notes have spacious keyboards and full-size function keys, they lack integrated pointing devices and have nonupgradable CPUs.

ON READER SERVICE CARD

effect in Microsoft Windows, which uses the entire screen. In place of a built-in pointing device, the Z-Notes come bundled with a Logitech Trackman.

Rather than using LED status lights, a small rectangular LCD panel (about the size of a 5.25-inch disk label) gives the status of such things as hard disk and floppy disk.

If you're looking for networking features, all three units are ready to go with built-in Ethernet-compatible ports and preinstalled client software. All that is required additionally is the \$89 Media Adapter for either a thin, twisted-pair, or 10BaseT cable. While no external expansion box is available, ZDS does offer a \$79 port replicator for speedy attachment and detachment.

Performance on PC Magazine Labs' suite of benchmark tests was above average for all three machines, although the 425Lnc ranks a bit higher than the other two models in most categories. Within its CPU group, the 425Lnc placed first on both the DOSmark and Disk Winmark test suites. This machine also performed exceedingly well overall on the video tests. The monochrome 425Ln has the best battery

life of the three units—4 hours 23 minutes on the Battery Rundown test and 8 hours 33 minutes on the ZDigit Rundown test with power-saving features enabled. Both of the color models also managed to turn in impressive ZDigit Rundown times: The active-matrix Lnc clocked in at 4 hours 17 minutes, while the passive-matrix Lnp lasted just over 5 hours. The straight Battery Rundown time for each of the color units was approximately 2 hours 30 minutes.

If you are in the market for a network-ready portable computer, you have a choice of three solid 486-based performers from ZDS. When choosing among the Z-Notes, your buying decision may depend largely on your display requirements.—Steve Chen

ZDS Z-Note 425Lnc Model 200

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **GOOD**

Windows applications **FAIR**

Desktop replacement **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW AVERAGE**

Repair service **BELOW AVERAGE**

Technical support **BELOW AVERAGE**

Zenith Data Systems

ZDS Z-Lite 320L

If you're looking for a small, lightweight subnotebook, the \$1,999 ZDS Z-Lite 320L will easily fit the bill. It's powered by a 20-MHz Intel 386SL processor and equipped with a 61MB hard drive. Memory can be expanded from 2MB to 10MB.

Like other units in this category, the floppy disk drive is external. What sets the Z-Lite apart are two PCMCIA Type II expansion slots.

In addition, the unique LitePoint two-button pointing device easily attaches to the front of the keyboard. It may be small, but the Z-Lite includes all the standard ports plus a PS/2 mouse port. It is missing a port replicator, however,



FACT FILE

ZDS Z-Lite 320L

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-808-4434

List price: \$1,999.

Tested configuration: 6MB 70-ns RAM, 61MB Seagate ST9080A IDE hard disk, 1.44MB external floppy drive, DOS 5.0, Microsoft Windows 3.1, LitePoint trackball.

Options: 2MB RAM upgrade, \$149; 4MB RAM upgrade, \$279; LitePoint trackball, \$89; extra nickel hydride battery, \$159; 14,400/9,600-bps PCMCIA data/fax modem, \$559; PCMCIA LAN adapter, \$299; external floppy disk drive, \$249; battery charger, \$59; extra AC adapter, \$109; worldwide power adapter, \$109.

In short: The Z-Lite 320L is a small and lightweight subnotebook with a clear display, good battery life, and plenty of expansion options via two PCMCIA slots. But performance is lacking and the keyboard is cramped.

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ZDS Z-Lite 320L

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **POOR**

Windows applications **FAIR**

Desktop replacement **POOR**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW
AVERAGE**

Repair service **BELOW
AVERAGE**

Technical support **BELOW
AVERAGE**

like the one found in the Z-Note family.

The unit's external monitor port supports simultaneous display, but only at 640-by-480 resolution. File-transfer software and cable are included.

The Z-Lite weighs less than 6 pounds and is slightly larger than the Zeos

Contenda to accommodate its larger 8.5-inch screen.

The 83-key compact keyboard does feel a bit cramped—even if you have small hands. The unit's Battery Rundown time of 3 hours 31 minutes is on the high side, as is its 4 hours 2 minutes on the ZDigit Rundown test, in which power-conservation features were enabled.

The Z-Lite 320L is a good unit with a clear display, but its slow 20-MHz 386SL processor makes it less than ideal for power users.—*Steve Chen*

Zenith Data Systems

ZDS Z-Sport 420S

ZDS Z-Sport 425S

If cost is a major factor in your notebook purchasing plans, take note that the Zenith Data Systems' ZDS Z-Sport 420S and ZDS Z-Sport 425S machines offer low price tags, but with fewer features and lower performance ratings than other reviewed notebooks in the ZDS family. These value-line models offer a good compromise between cost, processing power, and features.

Both of these machines use 20-MHz and 25-MHz Intel 487SX microprocessors, which are pin-compatible with the more widely used 486SX chips, but include an external math coprocessor, which gives them overall performance similar to 486DX chips.

The \$1,798 Z-Sport 420S includes an 85MB Conner hard disk and the \$2,098

425S offers a 121MB IDE hard disk. Both units include 4MB of RAM, which is expandable to 12MB.

Introduced before the 486-based Z-Note series of notebooks, both Z-Sport models offer a smaller 8.5- by 11-inch footprint. However, useful features such as built-in Ethernet connections and built-in pointing devices are missing in the basic Z-Sport models.

Instead of a port replicator, a connector is provided for an optional docking station. The keyboard is fairly standard, except that several of the function keys are slightly smaller than full-size. Moreover, the Z-Sports lack the full-travel key feel of some other notebooks in this roundup.

A pop-up screen in either DOS or Windows displays battery level and bat-

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FACT FILE

ZDS Z-Sport 420S

ZDS Z-Sport 425S

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-808-4434

List price: 420S, \$1,798; 425S, \$2,098.

Tested configuration: 4MB 70-ns RAM, 85MB Conner CP2084 IDE hard disk with 32K cache (420S), 121MB Conner CP2124 IDE hard disk with 32K cache (425S), 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, \$179; 4MB RAM upgrade, \$279; mouse, \$69; docking station, \$599; 2,400-/9,600-bps data/fax modem, \$199.

In short: Each of these well-designed, low-cost units offers good value and reasonable performance. Unfortunately, the Z-Sports lack a built-in pointing device. Both of these Intel 487SX/25-based units held up admirably when compared with reviewed portables equipped with 486DX CPUs. The 9.5-inch LCD screen appears sharp but suffers from slight bleeding in both DOS and Windows. The nickel hydride battery pack used by both machines delivered a decent 2 hours and 49 minutes on PC Labs' Battery Rundown test.

ON READER SERVICE CARD

ttery-saving features, such as the shut-down times for the hard disk and the LCD panel.

The 9.5-inch LCD screen appears sharp, but has slight but noticeable bleeding in both DOS and Windows. Adjusting the contrast reduces this, but gray shades in Windows still appear a bit washed out.

In DOS mode, there are blank spaces at the top and bottom of the screen. With the Z-Sports, there's no text-stretch adjustment like the one available in Z-Note models.

Automatic power-management features come standard with the Z-Sports. The nickel hydride battery pack deliv-

ered 2 hours 49 minutes on our Battery Rundown test for both machines. On our ZDigit Rundown test, in which power-management features are enabled, the 420S's battery lasted for 4 hours, but the 425S was not able to run this test.

Neither notebook's battery lasted as long as the monochrome Z-Note 425Ln Model 120, but both Z-Sports had endurance that was nevertheless respectable.

ZDS Z-Sport 420S

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW AVERAGE**

Repair service **BELOW AVERAGE**

Technical support **BELOW AVERAGE**

Both models produced respectable benchmark test scores in most categories when viewed alongside comparable 486DX-based portables. But both models showed weaknesses on our benchmark tests compared with all tested machines.

The units' video test scores were among the slowest of all the portable machines in this roundup. The 420S model turned in a better score in PC Magazine Labs' Disk and DOSmark performance tests than the 425S. On the other hand, the 425S produced a faster processor rating and a better Disk Winmark score than the 420S.

Compared with the latest Z-Note models, the Z-Sports are slightly out-of-date but still offer a good return for the price—as long as speed is not the feature on top of your notebook-purchasing wish list.

Just make sure you bring along your own pointing device.—Steve Chen

ZDS Z-Sport 425S

SUITABILITY TO TASK

Road warrior **GOOD**

DOS applications **FAIR**

Windows applications **FAIR**

Desktop replacement **GOOD**

VENDOR SERVICE & RELIABILITY

Reliability **BELOW AVERAGE**

Repair service **BELOW AVERAGE**

Technical support **BELOW AVERAGE**

Zeos International Ltd.

Zeos Contenda

In choosing the Zeos Contenda subnotebook, whatever you give up in keyboard perks and high-flying performance is more than made up for in this little unit's portability and affordability.

Even though the Contenda's keyboard layout lacks a separate inverted-T cursor pad and large key spacing, it still seems spacious for a unit of this size, and has room for a competent built-in trackball for right-handers.

As far as performance goes, the Zeos Contenda was about average compared with other subnotebooks in this roundup—the ZDS Z-Lite 320L, Dell 325SLi, and Compudyne 4SL/25 Sub-



FACT FILE

Zeos Contenda

Zeos International Ltd., 1301 Industrial Blvd., Minneapolis, MN 55413; 800-554-7172, 612-633-4591; fax, 612-633-1325

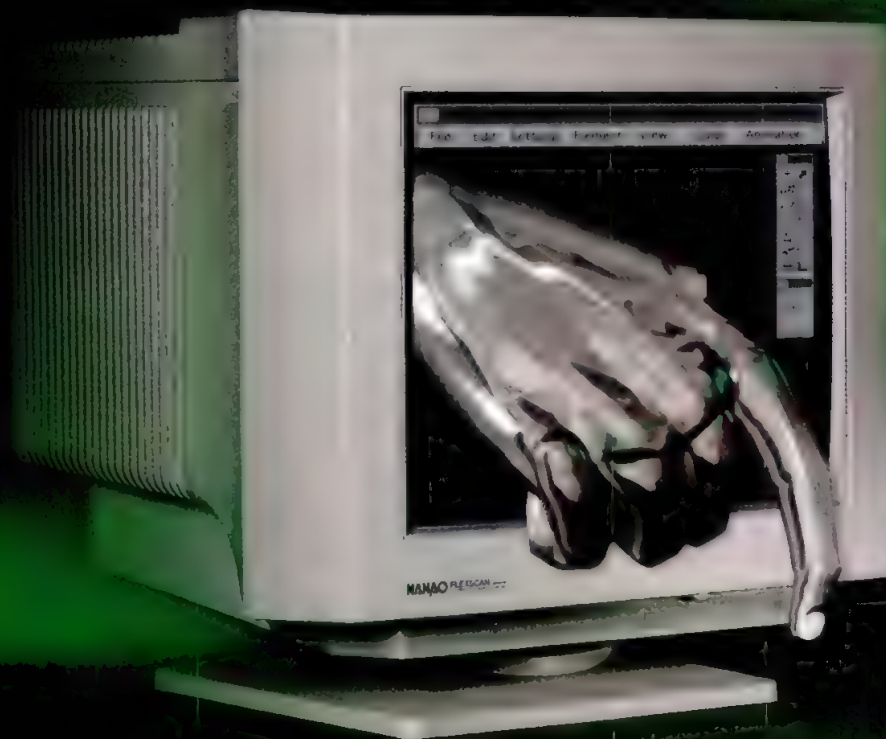
List price: \$1,894.

Tested configuration: 4MB 60-ns RAM, 80MB Toshiba MK1422FCV IDE hard disk with 32K buffer, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, Lotus Organizer, built-in trackball.

Options: 10MB RAM upgrade \$561; extra battery, \$99; Xircor Ethernet adapter, \$349; numeric keypad, \$79; battery charger, \$79; extra AC adapter, \$69; 12-volt battery adapter, \$49; Media Vision Audio Port, \$169; color SVGA monitor, \$399; FastLynx file transfer, \$79; nylon carrying case, \$79; leather carrying case, \$129.

In short: The Zeos Contenda, the smallest machine in this review, offered a nice display and performed well for a subnotebook with a 386SL/25 microprocessor. The unit's battery lasted almost 3 hours on PC Labs' ZDigit Rundown test.

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FlexScan F550W

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note. The Contenda consistently placed second or third on most performance tests, except for video, where it came in last. Surprisingly, the system's disk performance score was very close to that of the Compadre Subnote, which is a 486-based system.

On PC Magazine Labs' battery testing, the Contenda clocked in at 2 hours

Zeos Contenda	
SUITABILITY TO TASK	
Road warrior	GOOD
DOS applications	FAIR
Windows applications	POOR
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

38 minutes on the Battery Run-down test and 2 hours 52 minutes on the ZDigit Rundown test with system power-management features enabled, placing it in the same league with full-size units.

At \$1,894, the monochrome Zeos Contenda is also one of the lowest-priced

units in its 386SL/25 class, though its price tag is more in line with other subnotes.

With 68 regular and 12 half-sized function keys, the Contenda is just 6.1 inches across, making it the most diminutive

*The Zeos Contenda's
crisp, backlit screen, with
its 64 shades of gray,
is functional and quite good
compared with those of the
other subnotebooks
reviewed in this feature.*

notebook reviewed. The Shift, Enter, and Ctrl keys are the same size as the alpha keys, and the space bar is only about 1.5 inches long. The unit's total travel weight, including battery, AC adapter, and external floppy disk drive, is just 5.1 pounds

(4.1 pounds for the system without power adapter).

The unit we tested arrived at PC Labs with 4MB of system memory, although the Contenda may be upgraded to 10MB of RAM—but only by Zeos. The test unit also came with a 2,400-/9,600-bps data/fax modem.

Like the unit itself, the crisp, backlit screen, with its 64 shades of gray, is functional and quite good compared with those of other subnotebooks.

The Contenda supports simultaneous use of an external monitor and the built-in LCD and offers a maximum resolution on the external monitor of 800 by 600 with 16 colors.

Zeos offers toll-free technical support seven days a week, as well as a 30-day money-back guarantee and express parts replacement. On-site service is optional.

The Contenda's solid battery life and fair power management let you leave the 3- by 4.5-inch AC adapter behind for increased portability. And, for the price of this system, you'll be able to afford the trip.—Camille N. Cline □

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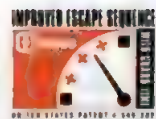
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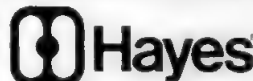


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CONTACT MANAGEMENT

Keeping in

They're not just for salespeople anymore: Today's powerful, easy-to-use contact managers offer effortless relationship tracking to the whole range of people-oriented professionals.

Touch

by Kathy Yakal

You're compiling a report when your phone rings. A vaguely familiar voice says, "Ms. Jones, this is Bob Wood. I'm following up on our conversation of October 15. Do you have that price quote I requested yet?"

You hunt frantically through the messages taped to your CPU, the notes scribbled on your wall calendars, and the loose papers scattered around your desk. You tell Mr. Wood that you have the quote, but you'll have to call him back. Mr. Wood replies that he's already received several good quotes from competitors, and yours is a week late. You're told that the return call won't be necessary.

Now let's rerun that scenario with one alteration. Mr. Wood calls. You quickly minimize your spreadsheet and open your contact manager. You search for the name "Bob Wood," and up comes a screen full of information.

"Yes, Mr. Wood," you say. "I faxed that quote to your assistant, Norma, a week ago, and she called to say she'd see that you got it. I left a message with her on the 18th, asking if you'd made a decision yet. By the way, how's your son's first year at Stanford going?"

Mr. Wood mumbles an apology, thanks you for asking about his son, and says he'll track down that fax.

While we tend to associate contact management with salespeople, other profession-

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als whose work requires quick access to detailed records of interaction with people and companies—like head-hunters and fund-raisers—have helped swell the ranks of contact management—software users in recent years. Evolving in the 1980s from products like Lotus Agenda, software for managing loosely structured information now makes up two arguably distinct classes: PIMs (personal information managers) and contact managers. While both employ contact databases and calendars, PIMs focus on a loosely structured organization of time and projects. Contact managers, by contrast, tend to use more heavily structured databases to record contact information and histories. Further, these complex database and search capabilities let contact managers massage data in ways most PIM users can only dream about.

We narrowed down an enormous list of candidates for this article by requiring that products offer some automatic logging capabilities, include free-form notes fields, have a built-in word processor or a link to an external one, offer a task list/calendar, and cost under \$1,000.

CONTACT-INTENSIVE SOLUTIONS

Compared with what you can fit in a Rolodex, address book, or business-card file, you can stuff a tremendous amount of information into a contact manager. More important, you can organize and recombine that data into powerful reports. In fact, for many users, the contact manager serves as a base of operations—the one application they run all day.

Contact managers make manual data entry as easy as possible. Some offer editable “pick lists” of commonly used responses (“sent quotation” or “returned call, left message,” for example). Most let you establish field defaults, so you can copy all or part of an existing record and edit only the fields that differ.

For those switching contact managers (or converting contact data over from a



EDITORS' CHOICE

- **ACT! for Windows**
- **GoldMine**

While there is a core of commonality between contact managers and PIMs (personal information managers), we see a clear difference in emphasis. PIMs focus on series of activities, usually loosely tied to a schedule or address database. Contact managers, on the other

hand, primarily address people, associations, and history.

Of the 16 products we culled for this roundup, the two that best handle the tasks of managing and massaging contact information are Contact Software International's ACT! for Windows and Elan Software Corp.'s GoldMine, each of which earned an Editors' Choice.

GoldMine showed the strongest performance overall, and though it shows a distinct sales orientation out of the box, it is fully customizable and adaptable to any environment. We judged ACT! to be the best standalone (non-networkable) contact manager, notable for its finely honed interface and resultant ease of use.

Another Windows-based contender, Richmond Technologies & Software's

Maximizer for Windows, earned an honorable mention. Having made the leap to Windows, this package shows great improvement over earlier versions and real potential as a top-notch contact manager.

STRIKING GOLD

GoldMine has just about everything you would want in a contact manager, either standalone or networked. One glance at its suitability-to-task scores makes this clear. But it goes far beyond the basics (indeed, far beyond contact management), offering users almost unlimited ways of associating and categorizing contact information. GoldMine accomplishes this by mixing together customizable screens and an unlimited number of fully indexed alphanumeric

commercially available database), data import is critical. Fortunately, most current contact managers import and export data in ASCII and dBASE formats. A few offer additional options, including direct import from competing products. Whether you're starting from scratch or converting, the best products let you attach more than one person to a contact record.

LEARNING FROM HISTORY

One of the most compelling reasons to use a contact manager is that it maintains

a complete history of your interaction with people and companies. Good contact managers can log phone calls, meetings, correspondence, store free-form notes, and prompt you to create reminders to follow up on calls and letters. So if you see an entry on your calendar that says, “Call Jim B. today,” but you neglected to note the reason for calling, you can pop up Jim B.'s history log to review your last interaction.

In most cases, finding a record by searching on a single indexed field (“last name,” for example) takes 1 second or less. But contact managers also offer more powerful functions that let you set complex search criteria.

Some, like ACT! and ACT! for Windows, let you look for a keyword anywhere in the database. This means you can search for, say, the word *lightbulb* in

Our Contributors: LORI GRUNIN is a former associate editor of and frequent contributor to *PC Magazine*. GREGG KEIZER is a free-lance writer for a variety of computer, technology, science, and entertainment publications. HENRY FERSKOWEISS is a frequent contributor to *PC Magazine*. KATHY YAKAL is a computer journalist who has covered the PC industry since 1983. TED STEVENSON was the associate editor in charge of this story, and BEN GOTTESMAN was the project leader.

contact profiles. True to its basic sales orientation, GoldMine also offers sales-analysis tools and branching telemarketing scripts.

In addition, GoldMine runs well on a network, offering a widely distributed contact database that makes it an especially good choice for larger organizations.

POLISHED ACT

ACT! for Windows performed nearly as well as GoldMine on our tests. Combining powerful contact-database and history functions with an easy-to-use graphical interface, ACT! for Windows makes good use of the inherent strengths of the windows environment. It offers DDE (Dynamic Data Exchange) links to other productivity apps and uses drag-and-drop for its nifty scheduling feature. The latter lets users easily link appointments with contacts and store all pertinent information to a contact history log.

While users can easily connect to external word processors, ACT! for Windows' built-in text handler is no slouch. It lets users adjust both layout and typography, add formatting options like headers and footers, and import graphics through the Clipboard. ACT! for

Windows also offers links to the HP 95LX Palmtop PC, an important consideration for users who travel. ACT! fell short only on our Extensibility task, mainly for its inability to run on a network.

Maximizer for Windows earns plaudits as a striking first entry into the Windows arena. It leaves behind many of the problems associated with its DOS predecessor—such as screen clutter and an inability to let users see the big picture. Despite an interface that occasionally requires the user to engage in minor keyboard and mouse gymnastics, and a notable inability to log initiated or completed tasks, this program's underlying contact structure—unlimited personal contacts grouped under client companies—makes for a logical and efficient organization of contact information. Unlike ACT! for Windows, Maximizer for Windows (and the DOS-based Maximizer Advanced, for that matter) is network-aware. It also uses far fewer system resources. A little more spit and polish on Maximizer for Windows' hood, and ACT! for Windows may find itself staring at a bumper. When GoldMine hits the Windows track, contact management may turn into a three-way dead heat.

almost any context in the database—whom you've discussed them with, for example, or companies that manufacture them:

Most contact managers let you define highly specific searches using Boolean logical operators (*AND*, *OR*, and so on). You might use these either to create tightly targeted mass mailings or phone campaigns or to develop demographic profiles of your client base. But since they involve nonindexed fields, such searches tend to be slow.

STAYING IN TOUCH ON PAPER

All of the contact managers reviewed here offer a way to produce written correspondence, through either an internal word processor or a link to your outside word processor. A few of these packages offer both—an optimal solution. This

makes simple document preparation fast and easy and gives you the power, formatting options, and familiarity of your own word processor.

You probably already have a word processor, but creating letters in your contact manager's internal editor can have advantages. The recipient's name and address, the date, and a salutation and closing can be automatically positioned on the letter and automatic notation of the letter can be stored in the recipient's history log. Many contact managers can also do quick and easy mail-merges for mass mailings. Moreover, most of these programs include fax support. Some packages simply print a cover sheet for transmission on a fax machine and record the transmission; other packages fax directly from the program with a supported fax board.

SHARING DATA

You'll find that you occasionally need to share data stored in a contact manager with other people. All of these products include report generators. While some limit you to a fixed set of prefabricated reports, the best packages let you define your own.

For more sophisticated data sharing, though, LAN support is crucial, and a few products we looked at excelled in this area. GoldMine, for example, was built from the ground up for network use. It integrates workgroup scheduling, e-mail, and contact management—linking meetings, messages, and activities to the contact. The program's remote data synchronization feature lets remote notebook users tie into the main system with just a few keystrokes.

Since contact data can contain personal or sensitive information, products like GoldMine and SmartOffice provide security for individuals, allowing them to protect their crucial information by hiding all or parts of some of their personal records or databases.

WINDOWS TO THE FUTURE

Windows has been a real boon to contact management. Task switching is easier. Products that are MDI (Multiple Document Interface) capable can show contact information, history, and notes simultaneously. As a DDE (Dynamic Data Exchange) server, a program can act as a phone book for your fax or communications software.

Several of the products reviewed here have begun to tap the power of Windows, while others are rapidly moving in that direction. In the meantime, programs such as GoldMine prove that you don't have to be in the Windows environment to provide first-rate contact management.

Contact Software International Inc.

ACT!

ACT! for Windows

BY KATHY YAKAL

There's good reason for ACT!'s ongoing dominance of the contact management field. Both the DOS and Windows ver-

Suitability to Task: Contact Management Software

In evaluating these 16 contact managers, we identified four critical areas to help us separate the best products from the merely good: contact database, scheduling, correspondence, and extensibility.

The heart of any contact manager is its **contact database**. Since most users these days already use some sort of electronic phone book or mailing-list utility, and since no one wants to rekey data, step one in our testing procedure was importing an ASCII database of more than 1,000 records into each package. We noted a package's ability to import data directly from a competing product.

We also sliced information into secondary databases, a procedure that is useful if you want to maintain a category separately ("all California clients," for example). We then looked for the ability to create contact groups within a database.

One key test for a contact manager is how well its designers were able to handle the fundamental trade-off between cramming lots of information on-screen and keeping things readable. Our evaluations of this aspect were necessarily subjective.

While the information content of the "perfect" contact screen depends on your specific needs, there are certain fields—such as company name, contact name, contact address, and multiple phone numbers—that any good program should have. Accordingly, we noted each program's standard fields. In order to adapt to personal needs, however, a contact manager must also offer a way to store and find user-defined information. We probed the depth and ease of each package's customizability.

Every time you deal with a new contact, you should enter a new record into your database. We

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Contact database	☒	☐	☐	☐
Scheduling	☒	☒	☐	☐
Correspondence	☒	☒	☒	☐
Extensibility	☒	☒	☒	☒

tested the ease of entering data and duplicating entries (the latter procedure often saves time when data between records overlaps). We also explored procedures for deleting contact records.

Ultimately, the most important mission of a contact manager is to find the data you need when you need it. For this reason, we thoroughly tested each package's search capabilities. A critical consideration here is how many fields—and which ones—are indexed for "instantaneous" retrieval. (For more information on each package's indexed fields, see the table "Indexing, Quick Search Power.") We also administered a series of tests involving searches across single and multiple nonindexed fields, as well as more complex Boolean searches.

Reporting is another important way of putting the information in your database to work. We tested each product's ability to output reports in a variety of printed formats, including calendar, phone directory, past and future activity report, and full contact record. Where possible, we also printed mailing labels from our test database.

Contacts are not maintained solely by phone; face-to-face meetings are often important. Accordingly, we administered a series of **scheduling** tests to evaluate each package's prowess at scheduling meetings, tasks, and phone calls, as well as its ability to tie them to one or more contacts. We also looked at

the packages' calendar systems, focusing on ease of data entry, clarity of appointment displays, and ability to resolve conflicts.

Also vital is a contact manager's ability to keep a complete and accurate history of contact interaction. Ideally, a package should automatically record each phone call, meeting, and piece of correspondence, offering you the option to add details easily. We checked to see how close each package came to this ideal. Since contact managers are natural sales tools for professionals, we also looked at telemarketing script support.

Written correspondence, faxing, and e-mail are parts of maintaining contacts, too. Under **correspondence**, we evaluated each product's integrated internal word processor or its links to external ones. We tested for the ability to draft quick letters, check spelling, and create mass mailings by mail-merging form letters; links between contact information and the word processor are paramount here. We determined whether the name and address of the currently displayed contact were automatically added to the form letter retrieved, and whether the sending of that letter was automatically recorded to the contact's history log. We also tested links to internal and external fax engines and LAN-based e-mail.

Extensibility is a contact manager's ability to operate in a wider domain than a single desktop, either through a LAN or remotely, via a laptop or a notebook. To evaluate this, wherever possible we installed products on a network and shared the databases among multiple users. Issues here were database integrity (record locking) and data security (privacy).

In the context of portability, we considered the amount of RAM and disk space required to run each package and its ability to *synchronize*, or reconcile, two or more versions of the database.

sions (\$395 each from Contact Software International) offer a comfortable balance of out-of-the-box usability and individual customization. Their design and combination of features simplify the chaotic task of organizing and maintaining your contact database.

Despite its wealth of features, ACT's interface remains uncluttered. Pull-down menus (and icons in the Windows version) divide functions into logical groupings. Both versions offer either keyboard or mouse navigation.

You add a contact by clicking on New Contact in the Edit menu (or by pressing the Insert key) and entering data in the

contact screen. Hit Tab or Return (or click the mouse) to move among the fields. Pop-up lists significantly simplify data entry.

Each ACT! record is presented on two screens. The first screen contains basic contact information (name, company, address, and so on), as well as information about upcoming events and the last interaction with the contact; it also contains nine user-defined fields. The next screen holds space for a second address and phone number for the contact, names of two alternative contacts, six additional user fields, and other important information. Each screen is easy to read, and the

user can quickly move between them by pressing F6.

ACT! for Windows offers eight alternative layouts from minimalist (Rolodex) to maximalist (Large Monitor). Users can't design their own layouts, however.

If you already have a database, you can import it in ASCII or dBASE format, though this process is much simpler in the Windows version since it offers a point-and-shoot mapping feature to reconcile different field orders. ACT! for Windows can also import most data from other packages, such as Polaris Software's PackRat, Richmond Technologies & Software's Maximizer, and Lotus Organ-

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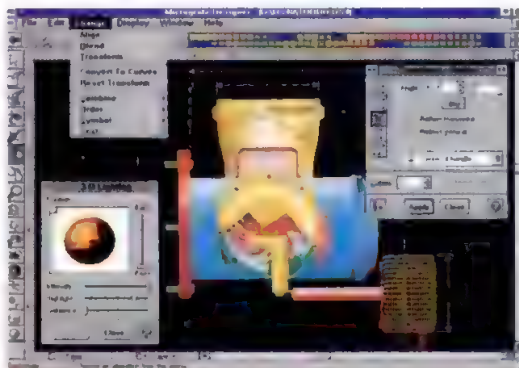
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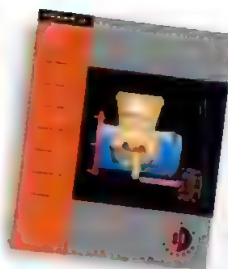
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SOFTWARE

Contact Management

izer. And both versions exchange data with other ACT! and 1stACT! databases.

When a contact's profile changes, simply make the changes on-screen. If several contacts from the same company require identical changes, you can search for them and make the changes across all the records simultaneously. If you want separate records for several contacts that share attributes (like company and address), you can create a new contact form that duplicates any field you specify and lets you make changes.

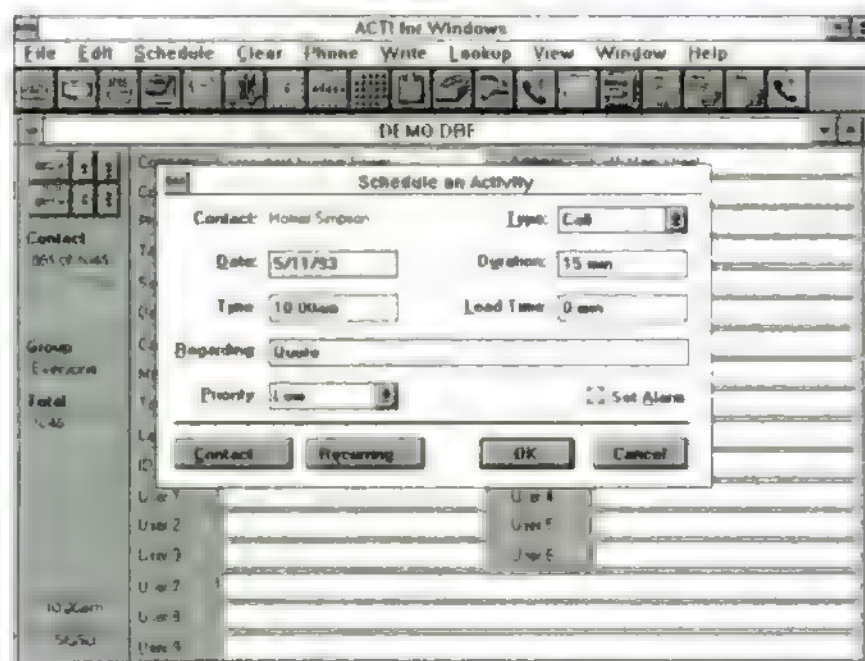
PAST PERFECT

Contact managers should keep detailed, accessible histories of client interaction. ACT! handles this beautifully. Select

ACT!'s search functions are powerful without being so complex as to require programming.

History from the View menu and you see a list of entries or changes made to any field that's been defined as a History field, each time/date stamped.

ACT!'s search functions are powerful without being so complex as to require programming. Commonly used searches (based on name, state, and so on) appear in the Lookup menu. The Windows version lets you customize this menu, offering searches for keywords that appear anywhere in the database. The DOS version zipped through our search routine. The Windows version's query engine, on



Scheduling activities in ACT! for Windows is simplified by pop-up calendars and drop-down pick lists.

the other hand, tested considerably slower. Both versions also perform Boolean searches.

RECONCILED

If you've loaded your ACT! database on a portable computer, the program's Merge feature will transfer the data back into your desktop, updating your home database. Both ACT! versions also have easy two-way links to the HP 95LX Palm-top PC.

ACT! simplifies the process of scheduling appointments, tasks to do, and phone calls. Pull down the Schedule menu, click on the desired type of event, and a calendar, clock, and list of activity types pop up. Here, you can schedule events and tasks using only your mouse (or you can enter them manually). All activities are entered into the contact's record and can be set to prompt you with an alarm and user-defined reminder.

In the Windows version, you can prioritize tasks, schedule recurring events, and carry undone tasks forward.

ACT WRITE

ACT! also automates your correspondence. The Windows version really shines here. While it offers DDE (Dynamic

Data Exchange) links to Windows word processors, its internal word processor includes features used most often in letter writing. You can specify type sizes, layouts, and type attributes; add formatting options like headers and footers; and import graphics through the Clipboard.

If you have the correct fax hardware (the DOS version supports Intel Corp.'s SatisFAXtion Modem and Hayes Microcomputer Products' JT FAX cards) and software (ACT! for Windows has a DDE link to Delrina Technology's WinFax Pro), you can send the document out as a fax. More important, you can use ACT! as your phone book for WinFax.

Mail-merges are simple. All you need to do is define the group, write the letter, and print. You can even print envelopes and labels. ACT! for DOS comes with an add-on program that prints in additional formats such as Rolodex cards and Day-Timer pages.

Both versions offer nine predefined reports (including Activities Completed, Future Activities, and Status Reports) and an unlimited number of user-defined

FACT FILE

ACT!

ACT! for Windows

Contact Software International Inc.,
1840 Hutton Dr., #200,
Carrollton, TX 75006;
800-365-0606, 214-919-9500;
fax, 214-919-9750



SUITABILITY TO TASK

ACT!

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	●
Scheduling	●	●	●	○
Correspondence	●	●	●	○
Extensibility	●	●	●	○

ACT! for Windows

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	●
Scheduling	●	●	●	●
Correspondence	●	●	●	●
Extensibility	●	●	○	○



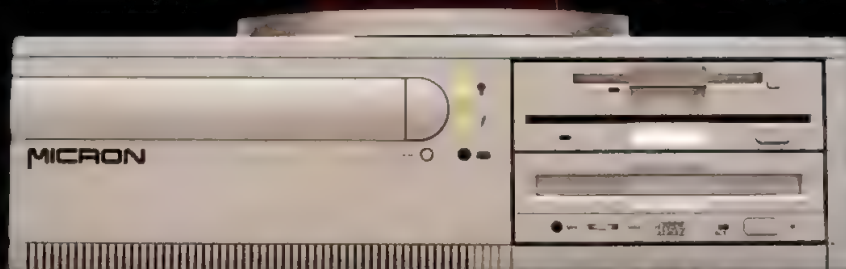
List price: \$395 each.

Requires: DOS version: 640K RAM, 2MB hard disk space, DOS 3.1 or later. Windows version: 3MB RAM, 2.5MB hard disk space, Microsoft Windows 3.0 or later; mouse is recommended.

In short: Available in both DOS and Windows versions, ACT! enjoys a continuing popularity that is well deserved. Novices can use either package straight out of the box with little setup, and more experienced users can customize their look and feel. The logical, clean user interface makes data entry and searches easy, and additional features simplify making and recording phone calls, writing letters, sending faxes, and compiling reports to get an overview of contact history.

ON READER SERVICE CARD

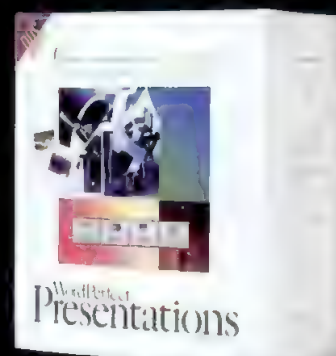
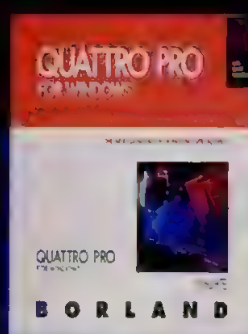
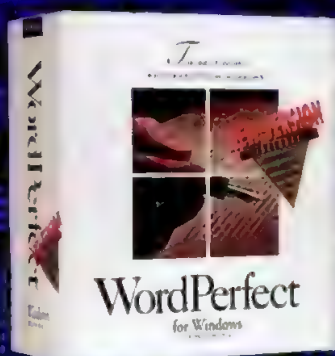
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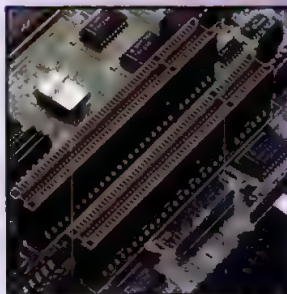
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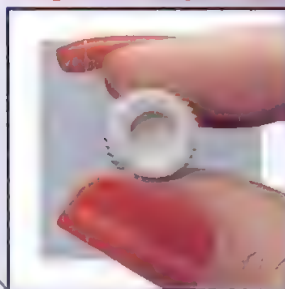
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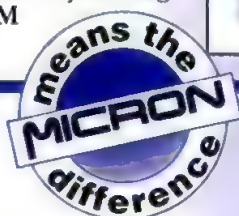
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- ▲ Microsoft Mouse 2.0 with Mouse Manager
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- ▲ Microsoft Mouse 2.0 with Mouse Manager
- ▲ MS DOS 6, Enhanced Tools, Windows 3.1
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- ▲ 16MB 70ns RAM (up to 64MB)
- ▲ 8 Slots: 2 VESA, 8 EISA (6 open)
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- ▲ Tower chassis with 7 drive bays (5 open)
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Contact Management

reports. Currently, only the DOS version of ACT! runs on networks.

Rather than trying to emulate ACT!, many contact manager developers have tried to excel by making products that are different and focusing on their individual strengths and designs. Yet ACT!'s universal appeal (it currently has 85 percent of the DOS market and 85 percent of the Windows market) and powerful simplicity are likely to keep it a favorite.

Action+Plus Software Inc.

Action+Plus—

The Executive Power Tool

BY GREGG KEIZER

Though it's got enough oomph to handle most standalone contact management tasks, Action+Plus Software's \$495 Action+Plus is even better suited as a groupware application for DOS shops where sales is king.

Installation—whether on a single PC or a server—is uncomplicated, though you must manually assign and provide passwords when networking among multiple users, even on an existing NetWare network.

Action+Plus's uncluttered interface may require nonstandard keystrokes, but it's still easy to operate. Thanks to configurable pop-up entry lists, you can quickly add and update information into virtually any field. You can also link contacts in a hierarchical relationship to track multiple contacts within one company.

A main screen holds the contact information, while supporting screens handle such chores as correspondence, maintaining or updating the calendar, and notetaking. The next scheduled event and the most recent notes are also on the main screen—where they belong.

Making phone calls and scheduling other events (the core business of any contact manager) are done via keystroke operations, as is viewing a history of written correspondence, meetings, and



Action+Plus's single screen shows the next future event and the most recent notes relating to each contact.

phone calls with a contact. Unfortunately, the program won't carry forward unfinished tasks unless you tell it to.

On the other hand, Action+Plus has several sales-automation tools that are missing from other contact managers. These include an invoicing and inventory system that tracks up to a billion inventory records, automatically decreases inventory when orders are placed, and generates invoices. Sales information is stored with the appropriate contact record. The program can also attach multiple .PCX-format images to any contact.

Action+Plus's scheduling, task crea-

tion, and task tracking are as good as those found in any DOS-based contact manager. For example, you can easily schedule recurring appointments, prioritize items on your to-do list, tie almost anything (an

appointment or a call, for example) to an individual, and keep copious notes on a contact.

Outbound communiques—whether letters or e-mail—are sufficient for the kind of correspondence you're likely to conduct with a contact manager. The word processor is merely adequate, but its mail-merge capabilities are extremely flexible, letting you create a form letter on the fly by inserting merge fields as you're writing a letter. Action+Plus also includes built-in e-mail that lets you cre-

ate, send, and (best of all) track electronic messages among users on a network. It also offers a terrific delegation tool called "Hot Task," which lets you assign tasks to other Action+Plus users—and receive notification that they've been completed—over its e-mail network. To top it off, the program's telemarketing features make it possible to build phone scripts that insert information directly from a contact record.

With more than 30 predefined reports and a bundled report-maker of its own, Ac-

tion+Plus puts the major contact information and completed tasks on paper. You'll need patience to roll your own reports, however, since the documentation is of little help.

Migrating to a LAN version isn't difficult and is especially attractive when you invest in the package's optional Action/Satellite module (\$350, or \$995 for a network package), which transfers data and reconciles and updates databases among remote sites. Action+Plus works on the road too—though you probably won't be satisfied with how it reconciles databases when you return. Also, moving data out of Action+Plus is difficult without Satellite, since the program can export data only in an ASCII fixed-link format via its reporting function.

FACT FILE

Action+Plus— The Executive Power Tool

Action+Plus Software Inc., 935 E. 7220
South, #108, Midvale UT, 84047-2393;
800-766-7229, 801-255-0600;
fax, 801-255-0642

List price: \$495.

Requires: 520K RAM, 10MB
hard disk space, DOS 5.0.

In short: Though it can match
such DOS stalwarts as Act! and
Maximizer Advanced in some
standalone areas, its groupware

abilities make it an even better choice when contacts
and telemarketing scripts must be shared.



ON READER SERVICE CARD

Contact Managers: Search Capabilities

Most of us don't care to spend our time searching for needles in haystacks, which is one of the reasons we buy contact management software. With the size of many users' contact databases ranging well into thousands of records, a contact manager needs powerful search abilities to cope. The ideal contact manager should function like a magic magnet, able to draw out the information you need when you need it.

Virtually every vendor of contact management software would agree that when it comes to performance, the most critical element is search speed—how quickly you can get to a record.

Each program we reviewed includes preselected fields that are indexed for fast lookups. Users typically want to execute searches based on company name, contact name, city, state, ZIP code, or phone number. The table below shows which of these fields each program indexes, as well as the number of other predefined fields and user-defined fields that are indexed. The tradeoff for such capabilities? Each additional index consumes more space and slows the process of adding and deleting records, because every index must be updated during these operations.

At PC Magazine Labs, we sought to measure the time each program takes to find records under various circum-

stances. We searched a 2,000-record database on indexed fields and non-indexed fields using Boolean searches ("last name = Smith AND city = New York," for example) and keyword searches (like finding *widgets* anywhere in any field).

The results surprised us; it seems that searching means different things to different programs. For example, both versions of the ACT! and Maximizer programs group the results of a search so that you can quickly see all the records that satisfy your search criteria. Big File Drawer and GoldMine, on the other hand, merely hop to the first record that satisfies the search. These programs then repeat the search and go to the next matching record.

Because of these different search techniques, the scores on these timed tests could not be fairly compared in a conventional performance-test graph,

and we decided to present some of them here in a more anecdotal fashion. The speed of searches in programs that use GoldMine's method of searching depend on the record you are viewing when you start the search and the order in which the records are sorted. In a program that sorts records based on company, you'll find that looking up, say, Xerox Corp. will be faster if you are currently at the Valley Green Country Club record than if you are at the Acme Products record.

Of all the contact managers here, only Commence and SuperTime were unable to search an indexed field in less than 1 second. Several products, including ACT!, Biz*Base Gold, Contact Plus Professional, In-Control, and Instant-Office, were able to perform the search in less than half a second.

There was a much wider variation in the speeds for nonindexed searches. Commence, which had the slowest time for an indexed search, barreled its way through the nonindexed searches in just over 3 seconds. Several other programs, including ACT!, Big File Drawer, Biz*Base Gold, In-Control, Instant-Office, Maximizer Advanced, Maximizer for Windows, and PowerLeads!, were able to complete these searches in less than 10 seconds. Contact Plus Professional, however, took over 1 minute for the nonindexed search, and ACT! for Win-

Indexing: Quick Search Power

Products listed in alphabetical order

PC MAGAZINE
EDITORS' CHOICE

☒ = YES ☐ = NO	ACT!	ACT! for Windows	Action+Plus—The Executive Power Tool	Big File Drawer	Biz*Base Gold	Commence	Contact Plus Professional
Indexed fields:							
Company	☒	☒	☒	☒	☒	☒	☒
First name	☒	☒	☒	☐	☐	☐	☐
Last name	☒	☒	☒	☒	☒	☒	☒
City	☒	☒	☐	☒	☐	☐	☐
State	☒	☒	☐	☒	☐	☐	☐
ZIP code	☒	☒	☐	☒	☒	☐	☒
Phone number	☐	☐	☐	☒	☒	☐	☐
Contact status/type	☒	☒	☐	☒	☐	☐	☐
Additional predefined indexed fields	None	None	3	3	2	None	1
User-defined indexed fields	None	None	3	2	5	None	2

* The first name can be used only as a filter in a last-name search

dows lumbered along, taking over 3 minutes to complete the task.

ROLL YOUR OWN

As you become more familiar with your contact manager, you will most likely use its user-defined fields to customize the program to your needs. For example, you may create a field called Account Manager, which you would want indexed because you often use account information to define your searches. Disappointingly, only a few of the programs here allow indexing of user-defined fields. Both Maximizer products stand out favorably, indexing all of their user-defined fields (which they call *categories*). Biz*Base Gold can only index nine fields at a time, but five of these—including any user-defined fields—can be user-specified. Surprisingly, fewer than half of the programs index a contact's first name. And Action+Plus—The Executive Power Tool, SmartOffice, and SuperTime let you search for a first name only in combination with a last name.

ALL ZIPPED UP

We found that many more programs search on ZIP code than on city or state. Knowing a ZIP code can be quite useful when defining sales regions, because all ZIP codes starting with the same two or three numbers are likely to represent

proximate areas. But since you're not likely to know hundreds of ZIP codes by heart, indexing ZIP code and not city or state seems counterproductive.

Most users would benefit from searches based on a combination of city, state, and ZIP code. Let's say, for example, you're going to Philadelphia on business. You look up your contacts in Philly and notice that ZIP codes in that vicinity start with 19. You could then broaden the search by telling the program to find all contacts with ZIP codes starting with those two numbers.

Often, you'll need to look up contacts based on more than one criterion. Say your company wants to open a new store in Montana. You'll need a lawyer in the state to help you set up the business, so you'll want to enter "state = Montana AND status = attorney." Or say you want to send a mailing out to all of your contacts who are suppliers or resellers. You might enter "state = Montana AND status = supplier OR reseller." The complexity of the search can grow and grow.

A few of the reviewed products stood out in this area. ACT! for Windows, although excruciatingly slow, has a very sophisticated function called Smart-Query, which walks the user through the search setup. Maximizer for Windows requires multiple steps. This is more time-consuming, but it might be some-

what easier for users not up on their Boolean syntax.

To perform an AND search in Maximizer for Windows, you first perform a search on the first criterion. Then you simply enter the next criterion and select Narrow List. For an OR search, choose Add to List. In-Control and Instant-Office were not able to perform searches with more than one criterion, and SuperTime could not search across fields.

DATA HUNT

In our final test, we attempted to search across entire databases for every occurrence of a given word. This process lets you act on the feeling that says "I know it's in there; I just can't remember where." Both versions of ACT! let you search everywhere, through the history log, contact notes, and lists of future activities. Big File Drawer searches everything but the notes. Instant-Office has a utility to look everywhere, but it only lists the records on-screen; you can't automatically go to them. None of the other programs offered this feature. A makeshift method—if you absolutely need this feature—is to enter a complex search by specifying the search word in every field in the database. In the end, however, you're likely to end up praying you never get into a situation where you really have to do this.



GoldMine	In-Control	Instant-Office	Maximizer Advanced	Maximizer for Windows	PowerLeads!	SmartOffice	SuperOffice	SuperTime
☒	☒	☒	☒	☒	☒	☒	☒	☒
☒	☒	☒	☐	☐	☒	☒	☐	☒
☒	☒	☒	☒	☒	☒	☒	☒	☒
☒	☐	☐	☐	☒	☐	☐	☐	☐
☐	☐	☐	☐	☒	☒	☐	☒	☐
☒	☒	☒	☐	☒	☒	☒	☒	☐
☒	☒	☒	☐	☒	☐	☐	☐	☐
☐	☐	☒	☒	☒	☒	☒	☐	☐
4	5	2	3	3	4	3	4	2
5	100	9	Unlimited	Unlimited	None	None	None	None

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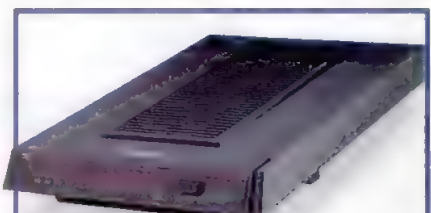


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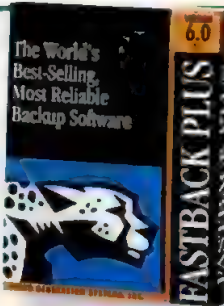


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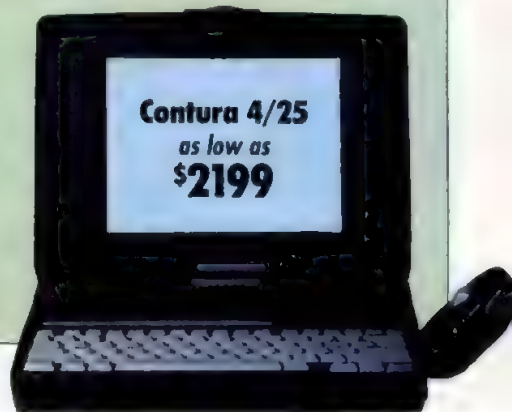
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Contact Management

Action+Plus is a capable but not first-rate single-user contact manager ideal for salespeople working in DOS. (A Windows version should be available by the time you read this.) But with its internal e-mail, integrated inventory and invoicing, and telescripting and task-delegation capabilities, it's a solid pick for sales teams connected over a network.

Small Business Computer Systems Inc.

Big File Drawer

BY HENRY FERSKO-WEISS

Big File Drawer, a DOS-based program from Small Business Computer Systems, concentrates on the basics: uncluttered screens, easy data import, and solid history logging. You won't run a large-scale, high-pressure telemarketing campaign with this \$395 program. But despite a sometimes awkward interface, Big File Drawer should make contact management easy for small businesses. Overall, our tests revealed Big File Drawer to be a competent performer in the areas of database import and querying but rather lackluster in scheduling.

Screens here are well organized. For example, the contact record has a section of fixed fields at the top of the screen, a comments area at the bottom, and a command list running down the left side. Tapping the "U" key brings up nine user-definable fields.

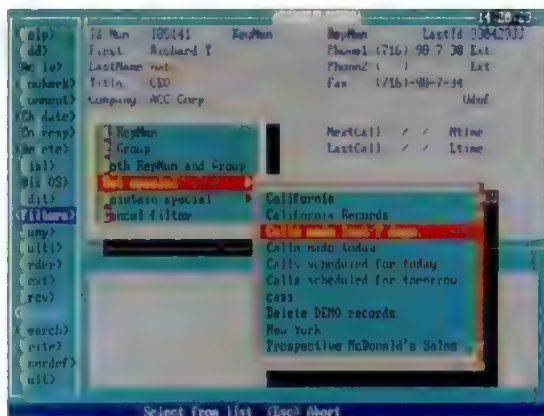
COMMANDS

The commands cover most of the important operations you'd want to perform directly from the contact record. They are

SUITABILITY TO TASK

Big File Drawer

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	○	○	○
Correspondence	●	●	●	○
Extensibility	●	●	●	○



The commands on the left side of the contact record let you access much of Big File Drawer's functional features, including filters.

single-keystroke commands, which makes it easy to jump around from scheduling activities and viewing multiple records to filtering the database and adding records.

Importing is quite easy because you can match the contact fields to the import fields by pointing and clicking. The program supports ASCII, dBASE, and FoxPro formats.

The interface, however, is awkward in places. You're forced to enter a unique identification number for each contact record, and if you're looking to create a sequence of numbers, you'll find there's no easy way to determine the last number you entered. Also, because of the color mix and the lack of window borders, you can't always tell where to grab a movable window to drag it out of the way. And the mouse can be quirky. Click on the Utilities menu after escaping out of the contact records area, and the program thinks you want to quit to DOS. Big File Drawer has no direct links to e-mail or fax packages, but it does let you launch other applications from a list.

LOGGED

As you would expect with any good contact manager, when you complete a call or send a letter, it gets logged to the contact's history field—which can be

found in the record's single Comments field. While this means that all your history is viewable from the contact record, it also means that the different types of history ("last meeting" or "last call," for example) are jumbled together.

Searching is fast and easy. You can run single- or multiple-field searches or complex Boolean searches by using the Filter command. You're prompted through the filter-creation process and can use pick lists that include operators

such as equals and less thans. Filters are saved so you can quickly retrieve records with just a few keystrokes.

One of the weakest areas is scheduling. You can't schedule an activity unless it's a next phone call. You don't have a weekly or monthly view, a to-do list, event alarm, or conflict checking.

Word processing is another of the program's weak areas. While you can easily merge contact data with a letter or memo, Big File Drawer gives you no text-attribute control or spell-checking capability. If you want to use an external word pro-

FACT FILE

Big File Drawer

Small Business Computer Systems Inc.,
P.O. Box 385, 809 N. Bethlehem Pike,
Spring House, PA 19477-0385;
215-542-9639; fax, 215-542-9784

List price: \$395.

Requires: 550K RAM, 2.8MB hard disk space, DOS 3.0 or later.

In short: Big File Drawer offers solid functionality and fast, easy operation. Its screens are well organized and uncluttered, and

you can perform many types of searches, including Boolean searches (via the Filter command). The program has some awkward interface elements, however, such as a quirky mouse. Also, there's no weekly or monthly calendar, to-do list, or group scheduling, and the word processor doesn't allow for text-styling or spell-checking. Yet for small businesses, this is still a satisfactory, easy-to-use program.



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Contact Management

cessor, you must pass it an ASCII file.

You can create almost any kind of report you want and alter the default reports. But to do this, you have to work in a FoxPro command window (the program is written in FoxPro). Since the manual doesn't cover the commands, you'll probably—unless you know FoxPro—have to stick with the default reports.

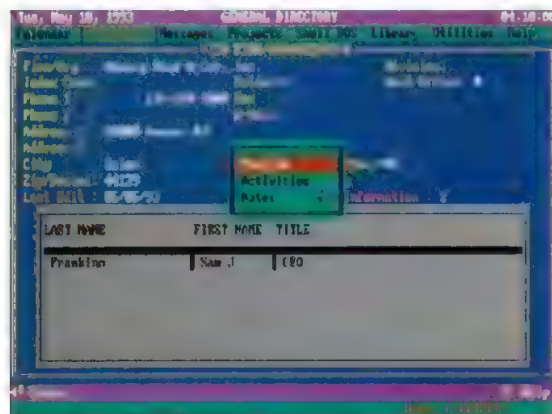
Although Big File Drawer's solid functionality and ease of use tend to outweigh its limited scheduling and word processing abilities, large, sales organizations should probably look elsewhere.

Biz*Base Inc.

Biz*Base Gold

BY TED STEVENSON

Managing contacts with Biz*Base Gold, Version 2.2, is a lot like driving a Mack truck. The product is big and powerful, and once you get up to speed, it can really fly. But the gearshift patterns are strange, the pedals aren't quite where you expect them to be, and the ride is a lot bumpier than it is in your family sedan. In this review, however, we'll concentrate on its strength and speed, since Version 3.0,



The Biz*Base auto-dialer/call-timer calculates client billings based on your billing rate, logs calls, and records other expenses.

should be available by the time you read this, and it promises to smooth out much of the bumpiness of Version 2.2.

While the features of this DOS-based, \$295 product cover a lot of ground, Biz*Base 2.2's primary focus seems to be managing follow-up phone calls or "recalls." Today's recalls occupy the most prominent of five active windows on the

SUITABILITY TO TASK				
Biz*Base Gold				
	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	●	●	○
Correspondence	●	●	●	○
Extensibility	●	●	●	○

opening Time-Management screen. (The other screens show nonphone follow-ups, appointments, "alerts," and tasks.)

CONTACT VIEW

By highlighting a recall and tapping Enter, you arrive at the Contact Record screen. Biz*Base 2.2 does a pretty nice job of presenting a good deal of information (name, address, phone number, background information, sales-oriented information, category labels such as *prospect* and *client*, and last-date-first free-form memos) without bewildering the eye. Field labels are easily changed, and data types can be changed for many fields. Thus, you have the freedom to set up the screen pretty much as you like. A second screen containing 21 additional fields is just a keystroke away.

Most of the functions you need (such as Find, Edit, and Copy) are accessed by single keystrokes listed at the bottom of the screen. Hitting Ctrl and F1 brings up a list of function keys that activate other modules—including calendar, task list, and word processor.

Biz*Base 2.2 flawlessly imported our 1,100-entry test database (but only after we converted it to dBASE format). It allows multiple databases of up to a billion records each, which ought to be enough for most people. Switching among databases is a snap.

Adding and modifying Biz*Base records is also fast and easy—once you've grasped the methodology. Records are easily duplicated, and deleting records is a quick, one-step, nonreversible process.

Biz*Base 2.2 searches indexed fields quickly, keeping nine indexes active at any one time. Users can custom-index any five of these. Simple and complex

nonindexed searches are carried out via a query builder that offers a full palette of Boolean logical operators while shielding users from the eccentricities of query language. Searches across multiple fields usually produce results in a second or less; finding the entire subset of records can involve pauses of a few seconds.

Biz*Base 2.2 logs phone calls—awkwardly—via its auto-dialer/call-timer. The only information automatically transferred to the contact screen is the call date. The appointment calendar offers several views, but, alas, you can't see your full day's appointments in any of them. Nor is there any automatic logging of appointments. Version 3.0 (which should be on the shelves by the time you read this) will make improvements here.

Biz*Base 2.2's word processor handles correspondence quite competently and features very powerful mail-merging, with a wide range of calculations and other database functions. Version 3.0 will add many amenities, such as envelope- and postcard-printing and preformatted quick letters and memos.

Among the "extras" we didn't test, are invoicing, inventory management, and accounts receivable. The network version adds group scheduling and an easy-to-use e-mail system.

Despite its rough edges, Biz*Base 2.2 has a devoted following. Version 3.0, (which will offer DOS and Windows in one box) appears to be much more polished and may well propel the product into top contact management ranks.

FACT FILE

Biz*Base Gold, Version 2.2

Biz*Base Inc., 16855 W. Vernardo, San Diego, CA 92127-1627; 800-833-8892; fax, 619-673-7399

List price: \$295.

Requires: 510K RAM, 3.5MB hard disk space, DOS 3.0 or later.

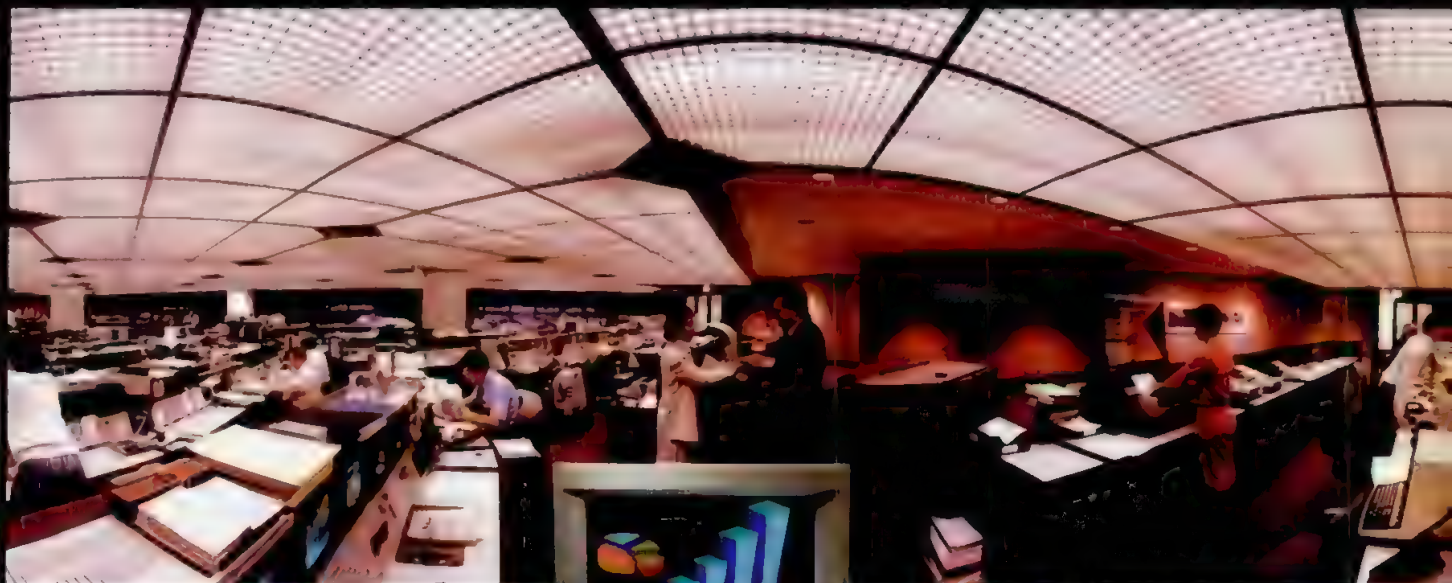
In short: This is a powerful contact management package with a quirky interface and indifferent documentation. Users intrigued

by the price should take a look at the greatly enhanced Version 3.0.



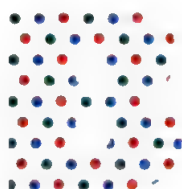
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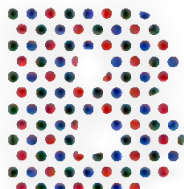


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Commence

BY KATHY YAKAL

Though Jensen-Jones's Commence (\$395), is regarded more as a PIM (personal information manager) than a contact manager, it offers the basic set of contact management tools found in all of the products reviewed here. Moreover, its Agents feature takes the automation of this process a step further. Comprising a set of user-defined conditions that trigger actions by the program, Agents—like many of Commence's features—takes some learning time. But the payoff is flexibility and powerful performance.

Commence's familiar Windows interface houses some unusual terminology. "Categories" refers to the types of information you want to store and what fields are included in the data screens (Person, Company, To-Do, Appointment, and so on). You can modify what's there or delete and add your own fields. In order to

SUITABILITY TO TASK

Commence

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	●	●	●
Correspondence	●	●	○	○
Extensibility	●	○	○	○

add a new contact record, you activate the Person category, click on the Add Item icon, and fill in the blanks. While Commence ships with predefined fields in each category, users can customize the category—adding, deleting, and modifying fields and connections to other categories.

One of the more unusual—and sophisticated—aspects of Commence is its handling of task, meeting, and phone-call data, as well as the way it connects this information among contacts. Each contact detail screen has several rectangular boxes with such labels as "Is Employed By Company," "Relates To Note," "Is Referred To In Letter Log," and "At-

tends Appointment." To establish a connection between a person and a company that already exists in the database, click the Connection Field button and point to the company name. If the company does not exist, click on the plus sign to the right of the box and fill in the blanks in the pop-up dialog box.

Commence's detail in all categories—to-do lists, meetings, phone calls, and so on—is also decidedly top-notch. Commence allows both simple searches and more complex Boolean searches, which it calls Filters. Sorted data (or complete databases) can be viewed in four different formats: book, calendar (daily, weekly, or monthly, which use color codes for different types of appointments), Gantt chart, and report (the default view).

NO SECRET

The Agents feature provides capabilities that are unusual in a contact manager. Though it has many levels of complexity, Agents in essence lets you define a trigger that makes an action occur. Take an automatic check of your weekly expense total,

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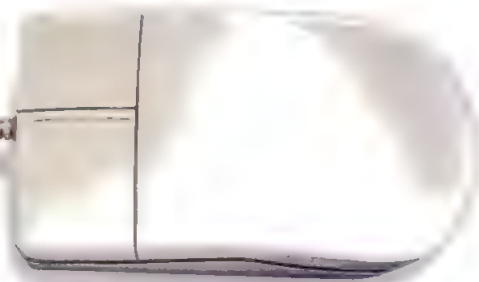
need retraining and new hardware? When will their product be available? A year from now? Two? Can you wait that long? Furthermore, have their systems been thoroughly tested?

Some accounting tempt you with can be very

Find out if they truly offer a full Windows solution today. Or are they baiting you with a promise? Will it integrate with their DOS product? Is there an easy path to Windows? How much does it cost? Will you

Chances are, you'll discover the technology they're trying to lure you with has more holes than a hunk of Swiss cheese.

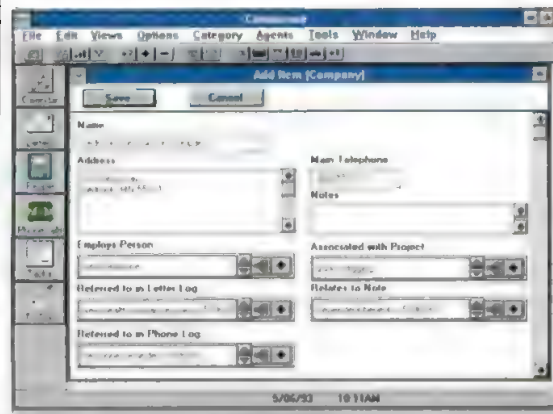
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Contact Management

for example; if the total exceeds a certain amount, a message pops up. You can also set up Agents to launch DDE (Dynamic Data Exchange) messages to other applications.

Commence defaults to Microsoft Windows Write for letter-writing, though it has DDE links to Lotus's Ami Pro and Word for Windows. Form-letter templates can be edited, and contact information can be used in a mail-merge.



Commence's data-entry screens allow easy access to connections among people, companies, and projects.

COMMENCING

There are 19 predefined and 200 user-defined reports to help you analyze relations with contacts in more depth.

While this version lacks networking abilities, Version 2.0 (which should be on the shelves by the time you read this) will offer workgroup capabilities. That upgrade will also offer fax connections, sophisticated digital telephone support, drag-and-drop scheduling and other calendar enhancements, database protection, and import scripts for ACT!, Polaris Software's PackRat, and Microsoft Windows Cardfile.

Commence is not the most intuitive contact manager in this group. Setup and learning time can be significant. But you're rewarded with a highly flexible, sophisticated contact manager that allows a great deal of customization. For power users, or for those who just need power, it's an intelligent buy.

FACT FILE

Commence

Jensen-Jones Inc., 328 Newman Springs,
Road Red Bank, NJ 07701;
800-688-7080, 908-530-4666;
fax, 908-530-9827

List price: \$395.

Requires: 2MB RAM, 6MB hard disk space, Microsoft Windows 3.0 or later.

In short: Commence's non-traditional methods of organizing contacts and setting up relationships may be hard to understand at first. But its core capabilities are first-rate. You can keep detailed records on people, companies, and projects and view them in a variety of ways. The program's level of customization is greater than many of the products here, and the handy Agents feature is a tool you can use to automate your client relationships even further. Casual users, though, should think twice before considering Commence.

COMMENCE:



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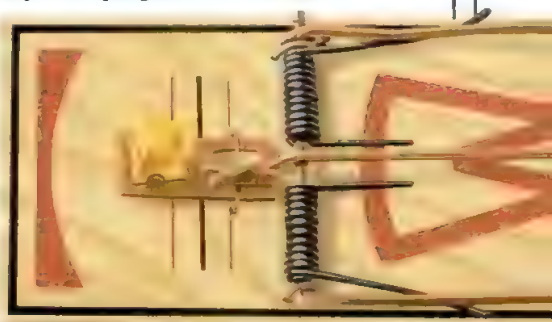
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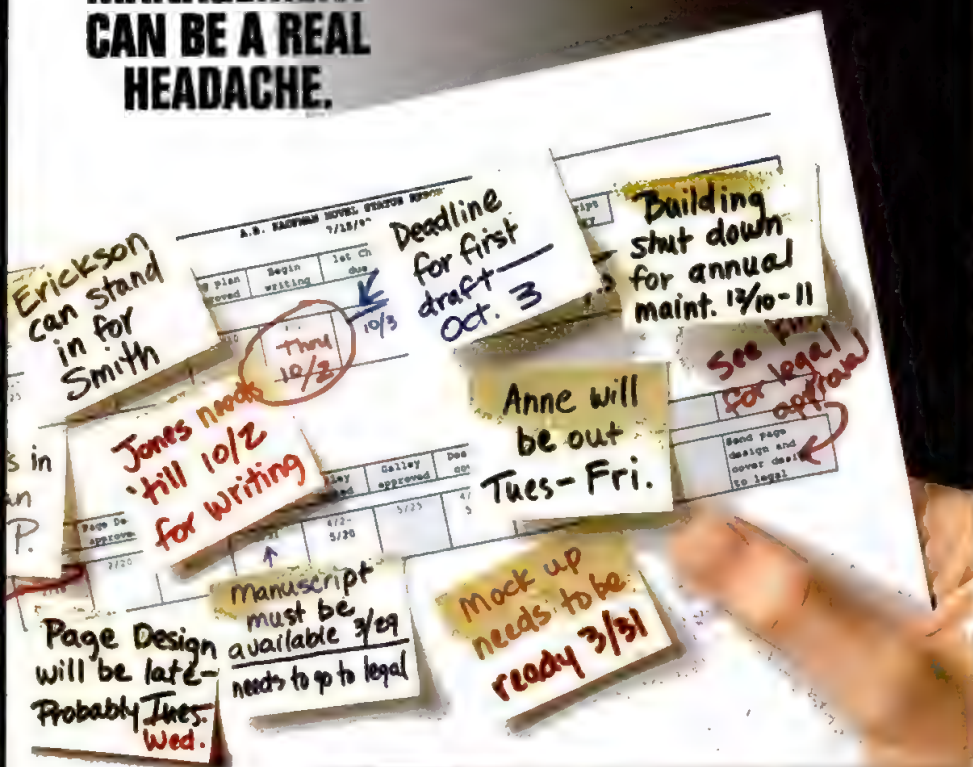


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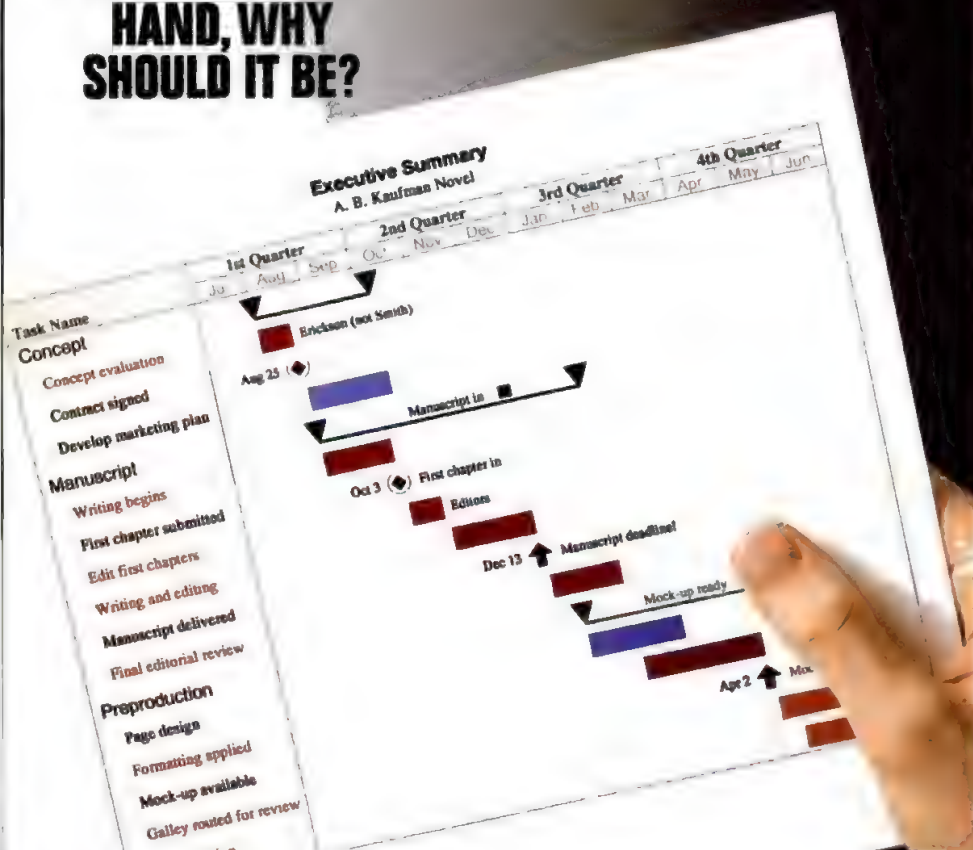
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■ Low-Cal Contacts

by Gregg Keizer

Less may be more when it comes to contact management. While full-featured programs like ACT!, Gold-Mine, and Maximizer pack considerable punch, many of their features are left untouched by casual users. They consume precious hard disk space on notebooks and portables, and to anyone working within a tight budget, they simply cost too much.

But scaled-down versions of several popular contact managers are available; these provide leaner feature sets, fit in tight spaces, and cost less. Typically, these slimmed-down products each offer a subset of their weightier parents' features—usually omitting the more advanced options—and limit themselves to a single database.

ACT ONE

1stACT!—from Contact Software International—is available in DOS and Windows flavors for \$79 and \$149, respectively. It leaves out such features as macro creation and SmartQuery, ACT!'s sophisticated search tool; 1stACT! for Windows also drops the graphical scheduling that makes ACT! for Windows so slick. Both 1stACT! packages limit you to a single contact database.

Richmond Technologies & Software offers Maximizer Lite, a \$79.95 slimline version of the DOS-based Maximizer Advanced. It too restricts you to a single database and drops power features such as macros and advanced reporting. The spell-checker dictionary is only half as large, and the calculator and expense tracking have been dropped.

SOMEWHAT LESS ACTION

At \$100, Action+Plus Lite, from Action+Plus Software, costs only a fifth as much as its full-figured forebear but, unlike other scaled-down contact man-

agers, runs multiple databases. On the other hand, it works with a stripped set of tools, omitting such features as a report writer, an alarm, and user-definable profile screens.

All these "light" contact managers handle the basic chores as well (or nearly as well) as their parents: All record and retrieve contact information, let you write letters, make and track phone calls, and keep your schedule up to date.

Since fewer features translates into less gluttonous space requirements, these programs are a boon to those traveling with small hard disks inside their notebooks. 1stACT! for Windows, for instance, is 25 percent smaller than ACT! for Windows, while Maximizer Lite fits on a single 3.5-inch floppy disk.

LESS, NOT MORE

All is not perfect in the low-calorie world of contact management, though. Unless you have the full version of the package on your desktop machine, you'll find it tough to merge data between one of these diet titles and your primary database in the office. And in the case of 1stACT! for Windows, the omission of drag-and-drop scheduling is a crippling blow.

Problems aside, these packages are a much better bargain in many cases (and even in the long run) than the more expensive originals, particularly for small businesses, home offices, and mobile workers. 1stACT! for DOS, for example, is a capable contact manager in its own right. Its inability to fax documents or build new reports won't be a disabling deficiency for most users.

Likewise, Maximizer Lite functions quite well, thank you, as a single-user application.

As long as you can deal with a single

database and do without some extras, these packages are an excellent entry into contact management—and a terrific way to extend your office environment when you're on the road. □

► **FACT FILE**
Action+Plus Lite

These slimmed-down products each provide a subset of their weightier parents' features, usually omitting the more advanced options.

Action+Plus Software Inc.,
935 East 7220 South, #108, Midvale, UT
84047-2393; 800-766-7229, 801-255-0600; fax, 801-255-0642.

List price: \$100.

Requires: 640K RAM, 3MB hard disk space, DOS 3.3 or later.

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► FACT FILE

1stACT! for DOS

1stACT! for Windows

Contact Software International Inc.,
1840 Hutton Dr., #200, Carrollton, TX
75006; 800-365-0606, 214-919-9500;
fax, 214-919-9750.

List price: DOS version, \$79; Windows version, \$149.

Requires: DOS version: 640K RAM, DOS 3.1 or later. Windows version: 2MB RAM, 2MB hard disk space, Microsoft Windows 3.0 or later.

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► FACT FILE

Maximizer Lite

Richmond Technologies & Software Inc., 6400 Roberts St., Burnaby, British Columbia, Canada V5G 4C9; 800-663-2030, 604-299-2121; fax, 604-299-6743.
List price \$79.95.

Requires: 512K RAM, DOS 2.1 or later.

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Contact Management

Contact Plus Corp.

Contact Plus Professional

BY GREGG KEIZER

Contact Plus Professional (\$295), which originated as shareware, is remarkably robust. It has enough potential power to satisfy those looking for an entry-level contact manager—especially those addicted to a word processor like WordPerfect. It's too bad, however, that Contact Plus doesn't realize that potential.

You can install the single-user version in minutes; the network version, though,

SUITABILITY TO TASK

Contact Plus Professional

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	●	○	○
Correspondence	●	●	●	○
Extensibility	●	●	●	○

demands you manually place "SET =" statements in each user's AUTO-EXEC.BAT file. Its configuration screens are cluttered but easy to complete.

Navigating through the contact information, however, is initially confusing. The program features nine primary screens for each individual contact. Included are two data screens, and one each listing calls, meetings, and letters. Several peripheral screens display features such as a history log and master calendar. It's easy to shift between screens and contacts: Simply press an arrow key. In fact, it's all too easy to move to another record accidentally when all you wanted was a look at the current contact's meeting log. Adding new contacts or updating old ones is much smoother, thanks to several customizable pop-up entry lists.

Contact Plus indexes only 6 of its nearly 40 fields—a frustrating limitation. Testing was time-consuming because a search forced the program to hunt through the hard disk, not memory. Fortunately, Contact Plus lets you assign as many as 17 of its 32 user-definable categories to each contact. This lets you further classify the person—by, say, sales potential or decision-making ability.

Since all categories are indexed, you can use them to conduct Boolean searches, in effect grouping all similarly classified contacts.

Unlike Maximizer Advanced, which also uses categories, Contact Plus features searches that don't narrow the list of displayed contacts to create a more usable collection. For instance, rather than show a small list of those contacts that share a category, Contact Plus forces you to step through the entire database to each matched contact and manually tag it before you can complete category-wide tasks. Nor does Contact Plus include such essential elements as the abilities to create prioritized to-do lists and set recurring events. In fact, even its scheduling capabilities are weak. The program limits the number of past, present, and future reminders, or ticklers, to just 15 per contact. After that, you must manually delete an old tickler before adding a new one.

The built-in word processor is fairly primitive, missing both a spell-checker and ruler. But Contact Plus links to several DOS- and Windows-based word processors, including Lotus's Ami Pro, Microsoft's Word for Windows, and WordPerfect. It even lets you quickly recall any document shown in a contact's history log. Contact Plus is particularly



Contact Plus lets you pop up the 15 ticklers atop each contact for quick review or view them in a list form elsewhere.

adept at WordPerfect-based mailmerges, thanks to an included WordPerfect, Version 5.x, macro that partially automates the process.

You can't alter the format of the 16 predefined reports, but since they all let you search the database by several criteria (including date and categories), they are effective templates for multiple user-defined reports.

Contact Plus's new network version is identical to the single-user program but allows for simultaneous access of a single record, notation of changes by user, and locked databases. But it doesn't let you set aside parts of a database as private.

Contact Plus is rough around the edges and lacks important pieces, which range from a usable manual to security features. But if you're seeking a program with tighter hooks into your favorite Windows word processor—and are willing to put up with a few weaknesses—it stands as an affordably priced entrance into the world of contact management.

FACT FILE

Contact Plus Professional

Contact Plus Corp., P.O. Box 372577,
Satellite Beach, FL 32937-0577;
800-366-9876, 407-779-4900;
fax, 407-779-3311

List price: \$295

Requires: 400K RAM, 2.5MB
hard disk space, DOS 3.3 or later.

In short: This product's
shareware still needs its rough
spots smoothed and its features

list enlarged before it can effectively compete. Even if you are on a budget, consider looking elsewhere for your contact manager.



ON READER SERVICE CARD

Elan Software Corp.

GoldMine

BY HENRY FERSKO-WEISS

At \$295, Elan Software Corp.'s GoldMine is an excellent, flexible contact manager that offers a mix of database, scheduling, sales-analysis, and tele-marketing features. These make it an especially ideal solution for large and dispersed sales organizations.

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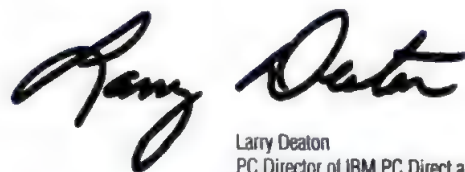
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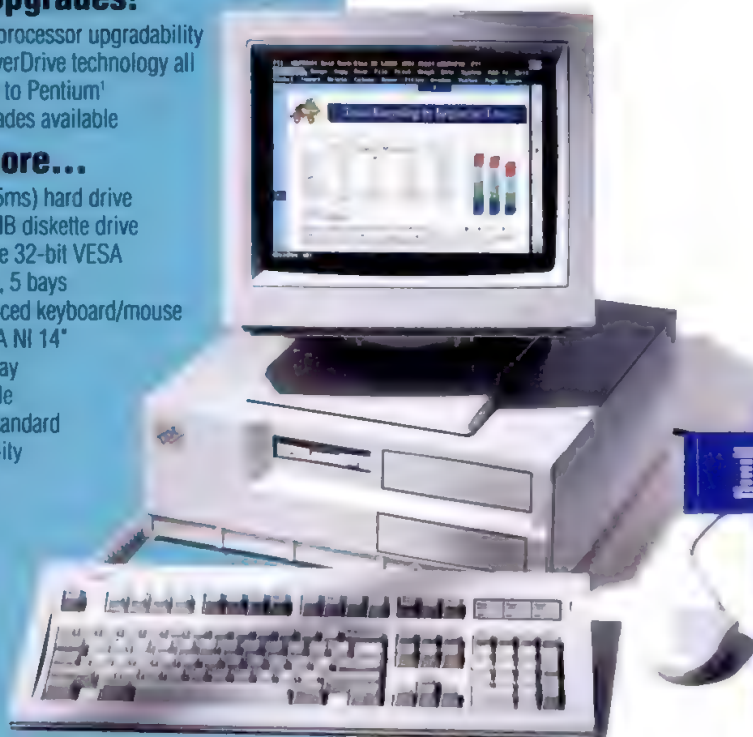
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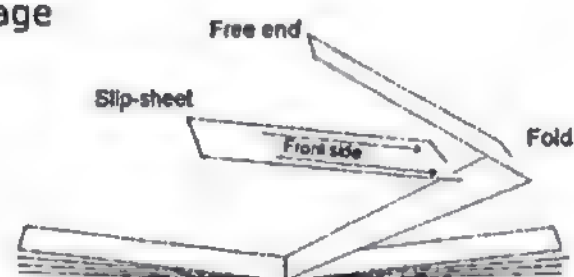
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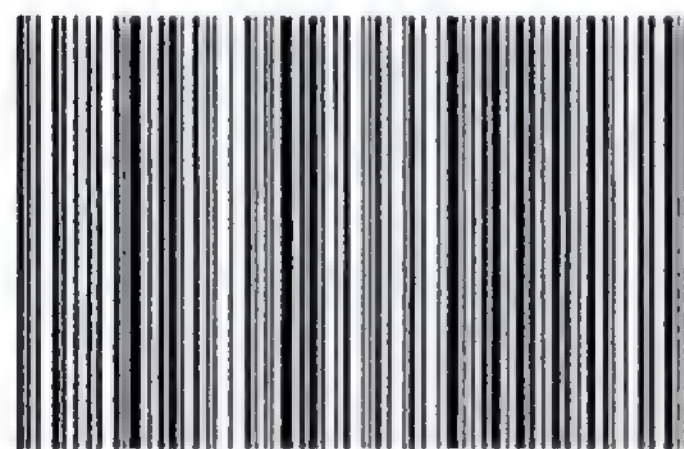
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3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

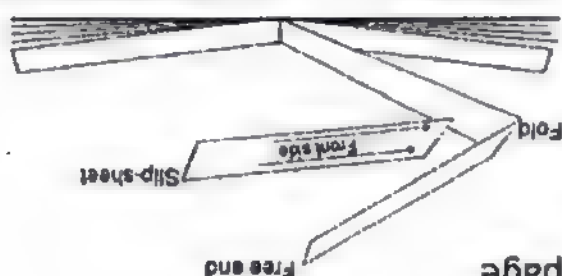


GbsSlipSheet-001

Folded edge of the page

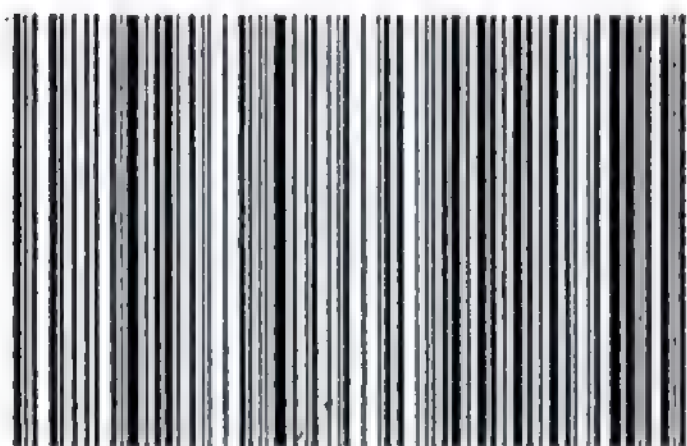
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 2. Arrow pointing to the fold
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1. Follow instructions on the other side

Inverted Back



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Back

1. Follow instructions on the other side

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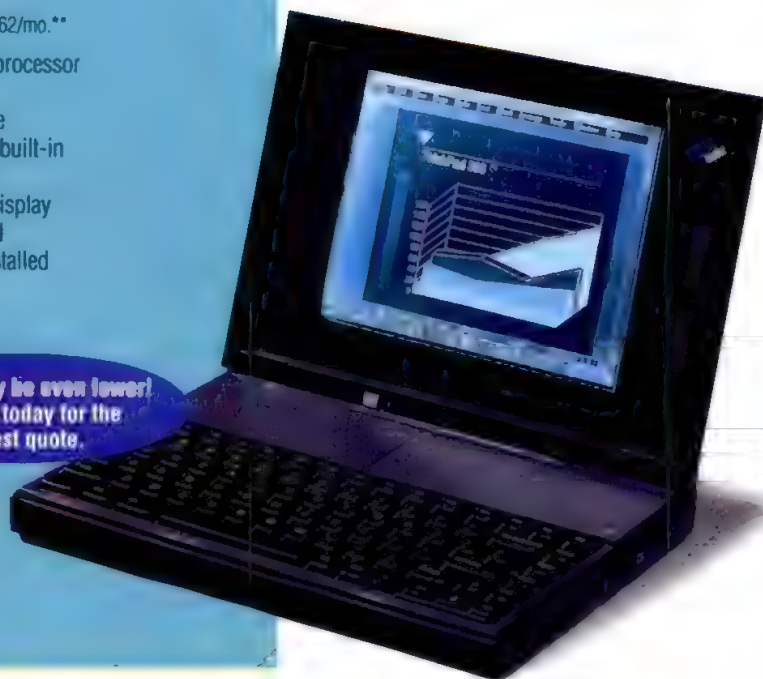
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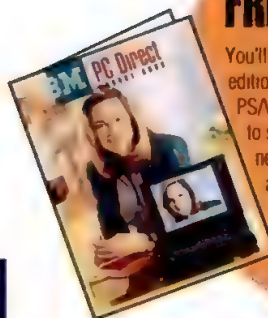
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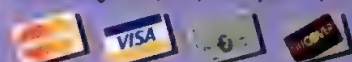
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Contact Management

SUITABILITY TO TASK

GoldMine

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	●
Scheduling	●	●	●	●
Correspondence	●	●	●	●
Extensibility	●	●	●	●

screens are uncluttered, many features reside under drop-down menus, and it employs easily accessed list views for groups of records, scheduled or completed activities, and contact histories.

Adding and editing contact records is generally easy. You can start with a partial or complete record form and duplicate the entries in another record or apply the record template. Many fields have editable lookup windows from which you can cull data. Unfortunately, the mouse stops functioning in the edit mode, so you're forced to move around by choosing a section of the record from a menu or by using the arrow keys.

DATA IN

Contact history can also be displayed on the main screen. All appointments, call backs, letters, and next actions get logged

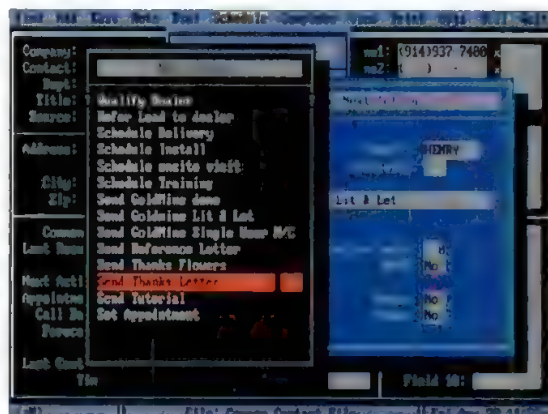
to history automatically. GoldMine can also accept imported field data in any order, assuming you know the order, smoothing out the import process. It supports ASCII and .DBF formats.

GoldMine offers two other powerful features for data entry: profiles and custom screens. Profiles are alphanumeric fields that you can attach to selected records. You can create an unlimited number of profiles for contacts, giving you tremendous flexibility in the amount of information you associate with each contact record. And since all profile fields are indexed, searching across them is nearly instantaneous. With the custom-screen feature, you can build up to 15 screens, mixing together fixed fields, user-defined fields, and profiles in any arrangement you want.

After information is entered, there are several ways to find individual data entries quickly. The Find menu lets you select single-field searches or searches across a group of fields, such as "all the user-defined fields."

Your other choice is to use a filter as a search tool. Filters use Boolean logic and can get quite complex. You can save a filter and apply it to build and save a group. Both of these operations take a little thought and time, so they're not appropriate for on-the-fly searches. Yet they are the only way to run user-defined multiple-field searches.

GoldMine has terrific scheduling features. You can schedule calls, appointments, actions, and tasks. The latter can be associated with yourself or linked to a record. If you're running the program on a network, you can group-schedule meetings or activities. All that you have to do is pick the users and resources that will participate, search for free time across all potential attendees by specifying a date and time range, post the meeting to the appropriate calendars, and request a reply. With these group-scheduling facilities, a manager can also assign multiple contact activities to the sales force. The product's other network features include record and file locking, as well as password security.



When you schedule an activity using GoldMine, you can use lookup windows. In a network environment, you can do group scheduling.

GoldMine also has some extras: built-in sales-analysis tools, branching telemarketing scripts, and the ability to merge updated records by field. Because of its rich assortment of flexible features and workgroup tools, GoldMine is a package especially well suited for large, networked sales groups.

Paul Sax, ACS

In-Control

BY HENRY FERSKO-WEISS

Version 5.0 of In-Control, from Paul Sax, ACS, is a grab bag of contact management features. In addition to letting you maintain traditional contact information and history, it supports graphics, background faxing, and expense tracking. In-Control also lets you build branching telemarketing scripts. A number of important features are limited in scope or awkward to use, however, and the program is stitched together with a maddening interface. Perhaps the most attractive characteristic of this shareware program is its \$99 price tag.

In-Control's problems begin with its manual. The type is small and dense,

SUITABILITY TO TASK

In-Control

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	●	●	○
Correspondence	●	●	●	○
Extensibility	●	●	○	○

PC FACT FILE

EDITORS' CHOICE

GoldMine

Elan Software Corp.,

17383 Sunset Blvd., #101, Pacific Palisades, CA 90272; 310-454-6800; fax, 310-454-4848

List price: \$295.

Requires: 470K RAM, 2MB hard disk space, floppy disk drive, DOS 3.1 or later.

In short: GoldMine blends a rich assortment of traditional contact management features with sales

analysis and telemarketing features. It has impressive scheduling abilities, particularly in a network environment—where you can set up group meetings and assign group activities. The History facility—which logs calls, appointments, actions, and letters—is separated from a general notes field. But each history item can also have a note. Minor drawbacks to the system are an awkward and limited word processor and a less-than-thorough implementation of a mouse.



ON READER SERVICE CARD

Contact Management

FACT FILE

**In-Control,
Version 5.0**

Paul Sax, ACS; P.O. Box 850427,
Richardson, TX 75085;
214-690-6017

List price: \$99.

Requires: 500K RAM, 1MB hard disk space.

In short: In-Control has a wide array of features for a product that only costs \$99. Additionally, its searches are quite fast, and

its history facilities are so complete as to list changes to contact-record information. Many of the program's features are limited, however. For example, you can't do multiple-field searches except in a report, and importing is rigid. Moreover, word processing is limited to setting margins. Another significant drawback is that reports can be customized only by sorting. You should consider this contact manager only if you can't afford a more accommodating package.

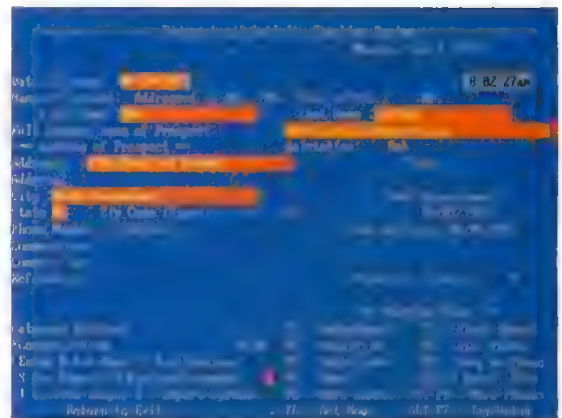
476 ON READER SERVICE CARD

there are neither page numbers nor an index, and the organization seems somewhat haphazard, to say the least. Program installation also presents a problem. The program automatically appends Files and Buffers statements to the end of your CONFIG.SYS file without asking—even if the values in the current statements are higher.

BREAKDOWN

The program is divided into a number of functional areas. From the main menu, you can go to the Prospect (contact records), Activities, or Reports files, or you can search through data. When you're in one area, you can't get to another without first backing out to the main menu, making it difficult to integrate your various bits of information.

Using many features requires reading explanations and answering true/false questions on one screen after another.



In-Control lets you dial the phone, schedule an activity, and view contact history directly from the contact record.

It's a relatively easy process to add records but only after leaving the active record area and going to an "Add" screen. Records can start out with the data from the previous record, which will save you time. The program gives you the ability to customize your records by including up to 100 user-defined fields, all of which are indexed. You might also add records by importing from an ASCII file,



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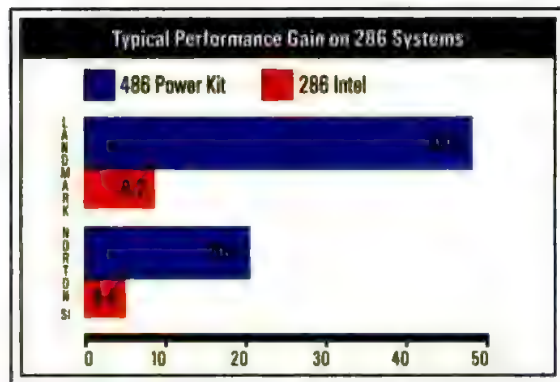
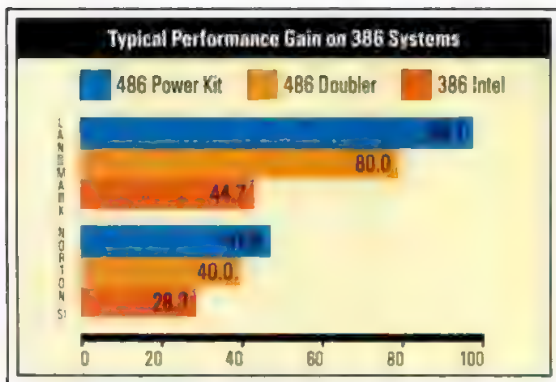
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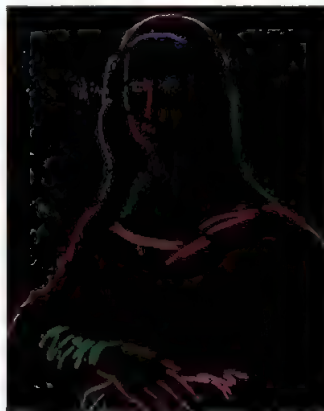
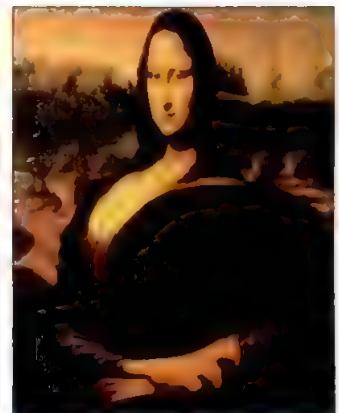
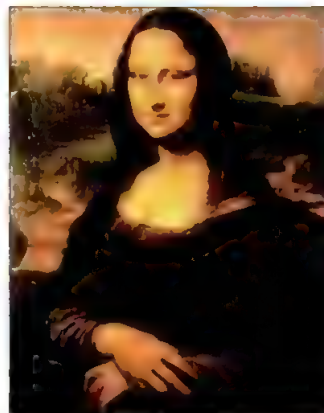
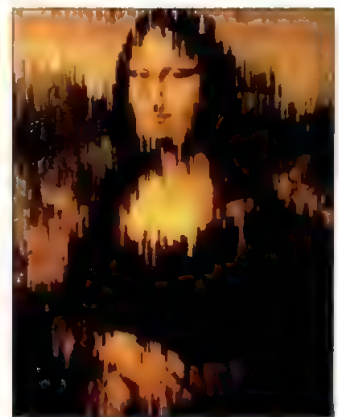
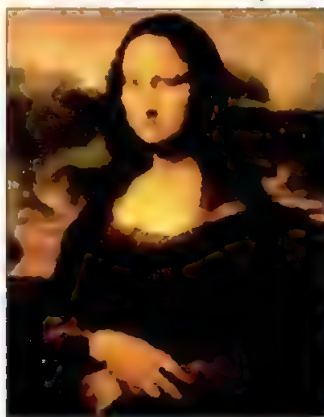
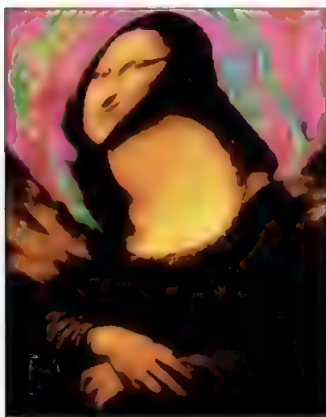
So there you have it — power, speed, ease, affordability, and reliability. This must be some kind of record.



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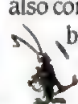
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Contact Management

but first you have to make sure your data is in exactly the field order specified by In-Control.

A LONG LOOK BACK

One of In-Control's best features is its history file. Everything gets logged here, from phone calls to appointments to pending activities. The history log can be accessed from the Prospect file as a "flash report." Also, users get a daily report of activities as soon as they have loaded the program.

For the most part, In-Control performed well on our querying tests; single-field searches in the program happen at lightening speed. A multiple-field search produces a static list of matching records, however. To get details on any one record, you have to leave the list and return to the Prospect file. Also, you can neither filter records by varying criteria nor display a list of records found in a search.

CUTTED

Many of In-Control's other features also seem to have been compromised in one way or another. The internal word processor, for instance, offers no choice of fonts. Nor does it offer control over text attributes. The built-in spell checker, moreover, finds misspelled words but doesn't suggest correct spellings or alternatives. In addition, the report facilities only let you choose a sort order and can't print in columns, making the reports somewhat difficult to read.

While In-Control performs rapid searches and has a good history facility and some interesting extras, the awkward, limited nature of many of its other features makes it worth considering only if you can't afford more. Users in this price range might be better off with one of the "lite" products examined in the sidebar "Low-Cal Contacts."

Dilworth Software Inc.

Instant-Office

BY GREGG KEIZER

Rube Goldberg's contraptions may have worked on paper, but when you apply similar techniques to contact managers, all you get is an clumsy pastiche of names, logs, and lists. Ultimately, Dilworth Soft-

ware's Instant-Office, a \$395 program that relies heavily on an external word processor for many of the tasks typically done within a contact manager, is more Goldberg than gold.

Installing Instant-Office, configuring it for use with a word processor, and importing names into its single database is typically a problem-free process. Much of the rest of Instant-Office isn't so simple,

SUITABILITY TO TASK

Instant-Office

	POOR	FAIR	GOOD	EXCELLENT
Contact database	☒	☐	☐	☐
Scheduling	☒	☒	☐	☐
Correspondence	☒	☐	☐	☐
Extensibility	☒	☒	☒	☐

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Contact Management

however. Although the bare-bones main menu is easy to navigate, we had a harder time maneuvering through the rest of the program.

One too many presses on the Esc key while in the primary contact screen, for instance, returns you to the main menu, something that can happen with distressing regularity—even when you're familiar with the program. Other common procedures, such as accessing lists of future

scheduled events or phone logs, are also cumbersome to execute.

PRESENTATION PROBLEMS

Instant-Office places the basic information—and little else—on the primary screen and offers a secondary screen with a dozen customizable fields. The program lacks such data-entry shortcuts as pop-up lists, however.

Only seven fields are indexed and are therefore searchable from the main screen. All indexed searches are fast, but searching for contacts based on other information—street address, say—is impossible without resorting to a report.

The program's phone and scheduling features are far from luxurious. Phone calls and meetings are logged, and you can view future commitments in the calendar, but you have to leave the main screen to view notes in list form. Nor does Instant-Office notify you

FACT FILE

Instant-Office

Dilworth Software Inc.,
P.O. Box 100,
Carmel, CA 93921;
408-624-6500

List price: \$395.

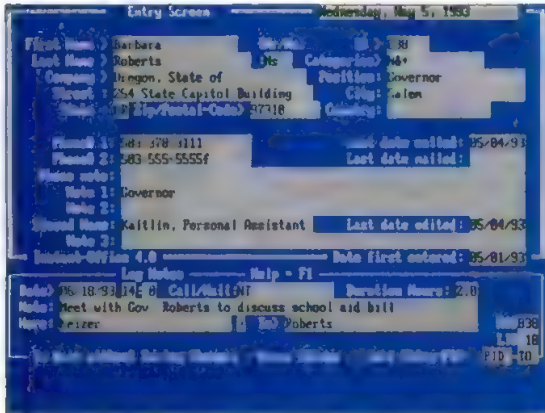
Requires: 168K, 985K hard disk space, DOS 2.1 or later.

In short: Because Instant-Office entrusts important components such as its to-do list and contact notes to an external word processor,

it is not able to automate such traditional contact management chores as time/date stamping of notes, automatic rollover of undone activities, or to-do-list prioritizing. Other crucial features are also missing from the package, from an ability to create multiple form letters to flexible, on-the-fly mail-merge. In the end, Instant-Office is an underpowered, overpriced product, and is unable to compete with the other contact managers in this roundup.



ON READER SERVICE CARD



Only one appointment, meeting, or phone note can be displayed at a time within Instant-Office's main contact window.

PC NETWORKING IS COMPLICATED, EXPENSIVE AND SCARY.

Contact Management

of possible scheduling conflicts.

Perhaps more distressing, Instant-Office lacks such an important scheduling feature as an integrated to-do list. The program instead depends on a text file opened by the external word processor, a technique that precludes the existence of such critical features as sorted priorities and automatic rollover of undone items.

In fact, this program relies more on its linked word processor than almost any other contact manager here, using it not only to write letters and send faxes but also to generate contact notes. This means Instant-Office will neither time/date stamp notes nor let you create custom form letters or perform a mail-merge that selectively culls information from contact fields as you're creating a form letter.

MALLEABLE REPORTS

Instant-Office does provide an extremely flexible, though daunting, query builder for generating reports. Using the program's 26 categories, for example, you

can selectively pull, then print, almost any piece of information from a subset of the main database.

You can use Instant-Office on a network and even let multiple users access the same record simultaneously. But its one-database-per-logical-drive restriction precludes easy sharing of multiple databases.

Over the long haul, Instant-Office just can't compete with the other contact managers here. Critical components are missing, and the program's tendency to fob off important chores to the word processor is a serious flaw. Considering what it doesn't have, Instant-Office is vastly overpriced.

Richmond Technologies & Software Inc.

Maximizer Advanced

Maximizer for Windows

BY GREGG KEIZER

With its reputation as a somewhat difficult-to-use program, Maximizer was

never able to compete effectively with ACT! in the DOS contact management market. Things have changed. Though its DOS offering, Maximizer Advanced, hasn't kept up with the times, Richmond Technologies & Software's newer Maximizer for Windows (like its DOS sibling, \$249) gives ACT! a run for its money. It may be as quirky as its predecessor, omitting several important contact management tasks (recording completed tasks and logging tasks, for instance), but Maximizer for Windows' flexibility, speed, stability, and low system-resource consumption mark it as a contact manager that simply cannot be ignored.

RICHMOND WAY

With Maximizer, Richmond took a different approach to contact management. Rather than depend on a one-contact-per-form view, both Maximizers link an unlimited number of contacts (people) with clients (companies) in a series of lists. And instead of depending on user-definable fields for extra information,

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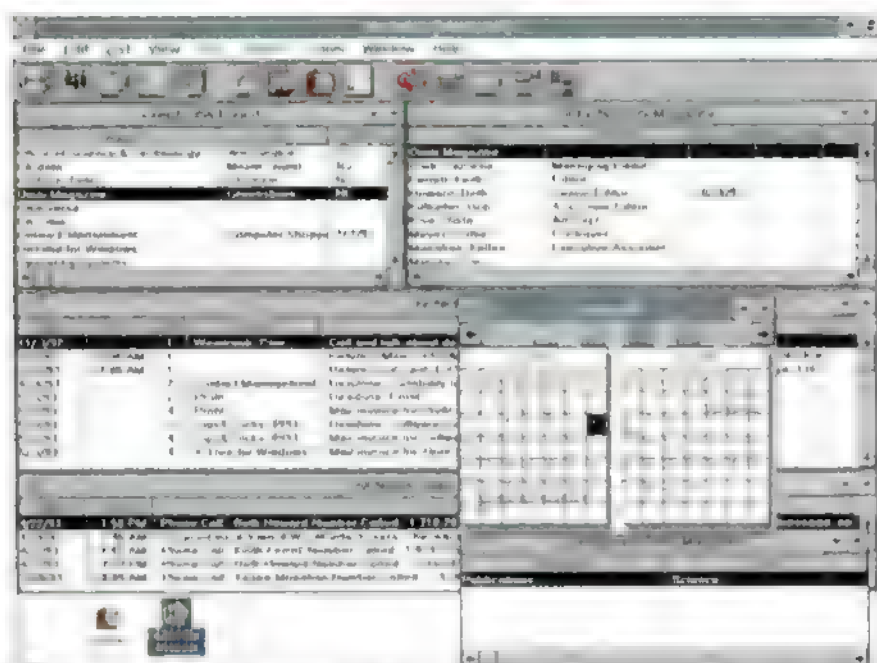
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Contact Management



Maximizer for Windows lets you arrange the interface by placing and sizing its many windows.

Richmond utilizes manipulative—and unlimited—categories (called *descriptions* in the DOS title) to associate records. The result is a package that works extraordinarily well in tracking groups of connected contacts, whether they work for the same company or simply share one or more of the definable categories.

Both versions start from the same place, but they don't finish together. Because the Windows product hands you multiple frames—one for the client list, another for the contact list, and so on—you decide how to view the contact data. As you scroll through the list of clients, for instance, the contact window stays in sync. The DOS version provides this same multiwindow approach, but because its frames invariably overlap, you'll have a harder time seeing either details or the big picture.

Entering data is simpler in the DOS program, since creating a client and several subordinate contacts is a linear process at the keyboard. In the Windows version, you're forced into minor mouse and keyboard gymnastics. To add a new client and a single associated contact, for instance, you're forced to work in two separate windows.

On the other hand, the Windows package provides slick data import and export functions, with excellent field matching and mapping when you move contact information in and out of the program.

MAX CONTACT

Both programs provide nearly everything you'll need to make phone calls, schedule follow-ups, and record and review your

contact history. Scheduling in the Windows version is superior to scheduling in the DOS version, because the former includes recurring appointments, an alarm, and a prioritized to-do list. Phone calls are logged automatically in both versions, an unlimited number of notes can be attached to any contact, and a history log is available. Several important scheduling tasks, however, are omitted from both programs, including recording of completed appointments and meetings and logging finished tasks. Maxi-

mizer for Windows searches large numbers of contacts quickly. Building Boolean queries based on one or more categories is simple; it's just a matter of selecting one or more categories from a list.

The combination of unlimited categories/descriptions and fast searching lets you collate your contacts in an almost infinite variety, easily forming ad hoc sub-

FACT FILE

Maximizer Advanced

Maximizer for Windows

Richmond Technologies & Software Inc.,
6400 Roberts St., #420, Burnaby, BC
V5G 4C9; 800-663-2030, 604-299-2121;
fax, 604-299-6743



List price: \$249.

Requires: DOS version: 512K RAM, 2MB hard disk space, DOS 2.1 or later. Windows version: 2MB RAM, 3MB hard disk space, Microsoft Windows 3.0 or later.

In short: Maximizer, available in

both DOS and Windows versions, applies a different philosophy to contact management. Rather than work in a form-like view, Maximizer packages use lists to connect an unlimited number of contacts with any company and pigeonholes people with user-definable categories. While the DOS version can't compete with high-powered programs such as ACT! or even Action+Plus, its Windows sibling is flexible, fast, and an extremely capable contact manager that can compete with anything on the market.



ON READER SERVICE CARD

SUITABILITY TO TASK

Maximizer Advanced

	POOR	FAIR	GOOD	EXCELLENT
Contact database	☐	☐	☐	☐
Scheduling	☐	☐	☐	☐
Correspondence	☐	☐	☐	☐
Extensibility	☐	☐	☐	☐

Maximizer for Windows

	POOR	FAIR	GOOD	EXCELLENT
Contact database	☐	☐	☐	☐
Scheduling	☐	☐	☐	☐
Correspondence	☐	☐	☐	☐
Extensibility	☐	☐	☐	☐

groups. In the Windows version, this combination even lets you store those subgroups for later recall.

Outbound correspondence is well handled in both versions by a built-in internal word processor, though the Windows program also offers DDE (Dynamic Data Exchange) links to external word processors. On-the-fly mail-merge, where you're entering fields from a contact record as you compose a letter, is a snap with Maximizer for Windows.

Reporting is adequate in both, though compiling summary information about completed activities by contact is weak.

LINKED

Both Maximizers can connect over networks. The Windows product, in fact, is network-aware as is and includes a slick data transfer tool to move contact information between databases. Both are also strong performers when it comes to synchronizing data between portable and desktop machines.

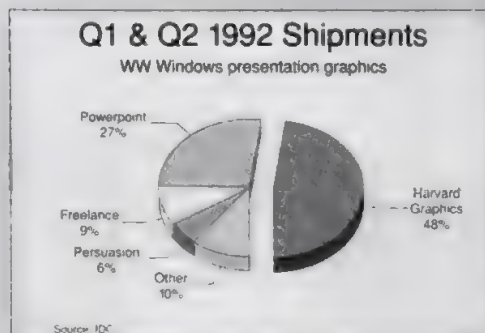
Overall, the Windows version shines brightest. Its low system-resource consumption—a mere 5 percent—makes it a good pick when you're serious about multitasking, and its stability keeps data alive, even when the system goes down unexpectedly. You may have a hard time assimilating with the program (the list-based approach takes some getting used to), but, in the end, Maximizer for Windows is an extremely capable contact manager suitable for anyone who tracks more than a handful of people associated with any one organization.

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SOFTWARE
Contact Management

► **S U M M A R Y O F F E A T U R E S**

Contact Management Software

Products listed in alphabetical order

PC MAGAZINE
EDITORS' CHOICE

■ = YES □ = NO

	ACT!	ACT! for Windows	Action+Plus— The Executive Power Tool	Big File Drawer	Biz*Base Gold	Commence	Contact Plus Professional
List price	\$395	\$395	\$495	\$395	\$295	\$395	\$295
Site licenses available	■	□	□	■	■	■	■
Network version available	■	□	■	■	■	□	■
List price	\$1,295 (5 users)	N/A	\$995 (5 users)	\$895 (unlimited users)	\$695 (4 users)	N/A	\$895 (5 users)

Standard Screens

Maximum number of databases	Unlimited	Unlimited	10,000	1	Unlimited	50	Unlimited
Maximum number of records per database	Unlimited	Unlimited	Unlimited	Unlimited	1 billion	8,000	Unlimited
Fields included:							
E-mail carrier	■	■	□	□	□	□	□
Fax number	■	■	□	■	■	■	■
Customer ID number	■	■	□	■	■	□	□
Referred by	■	■	□	■	□	□	□
Customizable data entry lists	■	■	■	■	■	■	■
Maximum number of user-defined fields	29	70	Unlimited	Unlimited	50	49	16
Maximum number of phone numbers per contact	4	4	3	3	4	3	3
Maximum number of alternative contacts per record	2	2	Unlimited	1	Unlimited	N/A	2

Contact Management

Searches multiple fields	■	■	■	■	■	■	■
Boolean searches	■	■	■	■	■	■	■
Saves queries	■	■	■	■	■	■	□
User-defined contact groups	■	■	■	■	■	■	■
Free-form text fields	■	■	■	■	■	■	■
Maximum number of characters	Unlimited	Unlimited	35,840	Unlimited	65,536	30,000	Unlimited
User can cut and paste to and from fields	■	■	■	■	□	■	□

Data Import/Export

Imports/exports ASCII files (delimited)	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ ■
Imports/exports ASCII files (fixed-length)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	□ □
Default database file format	Proprietary	.DBF	.DBF	FoxPro	.DBF	Proprietary	Fixed-length field
Can import from other contact managers	■	■	□	□	■	■	■
Can reconcile duplicate entries	■	■	■	■	■	■	■

Call Automation

Automatic redial	■	■	□	□	■	□	□
Global dialing prefix adjustment	■	■	■	■	■	□	■
Maximum prefix length (characters)	70	70	24	100	40	30	30
Maximum suffix length (characters)	60	60	16	10	40	4	30
Local area-code adjustment	■	■	■	■	■	■	■

History

Phone-call time and date stamp	■	■	■	■	■	■	■
Last action taken recorded:							
For all fields	■	□	□	□	□	□	□

N/A—Not applicable. The product does not have this feature.

SOFTWARE
Contact Management

CONTINUES



GoldMine	In-Control	Instant-Office	Maximizer Advanced	Maximizer for Windows	PowerLeads!	SmartOffice	SuperOffice	SuperTime
\$295	\$99	\$395	\$249	\$249	\$295	\$595	\$395	\$295
☒	☐	☒	☒	☒	☒	☒	☒	☒
☒	☐	☒	☒	☒	☐	☒	☒	☒
\$895 (5 users)	N/A	\$895 (per server)	\$149 (per user)	\$149 (per user)	N/A	\$1,795 (5-9 users)	\$1,295 (5 users)	\$695 (4 users)

Unlimited	1	1 per drive	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	1	Unlimited
Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	1 million	4 billion	Unlimited	Unlimited
☐	☐	☐	☐	☐	☐	☐	☒	☐	☒
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☒	☐	☐	☒	☒	☒	☒	☒	☒	☒
Unlimited	100	12	6	None	10	38	3	None	None
Unlimited	20	3	4	4	2	5	1	5	5
Unlimited	100	N/A	Unlimited	Unlimited	N/A	4	50	Unlimited	Unlimited

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Unlimited	15,000	Unlimited	8,000	9,000	4,096	80	40	4,096	4,096
☐	☐	☒	☒	☒	☒	☒	☒	☒	☐

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☒	☐	☐	☐	☐	☒	☐	☐	☐	☒
.DBF	.DBF/.DBT	Fixed-length field	Btrieve	Btrieve	Superbase	C-Tree	C-Tree	C-Tree	.DBF
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☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
15	30	20	39	39	20	9	100	20	20
15	30	N/A	39	39	20	N/A	100	N/A	N/A
☒	☒	☒	☐	☐	☒	☒	☒	☒	☐

☒	☒	☒	☒	☒	☒	☒	☒	(date stamp only)	☒
☐	☐	☐	☐	☐	☐	☒	☐	☐	☐

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SOFTWARE
Contact Management

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order



■ = YES □ = NO

	ACT!	ACT! for Windows	Action+Plus— The Executive Power Tool	Big File Drawer	Biz*Base Gold	Commence	Contact Plus Professional
History (continued)							
In free-form text file	□	□	□	■	□	□	□
In log file	■	■	■	□	□	■	■
Automatic follow-up reminder	■	■	■	■	■	■	■
Can purge historical records by date range	■	■	■	■	□	■	■
Scheduling							
Calendar	■	■	■	■	■	■	■
Time scale	■	■	■	■	■	■	■
Adjustable	■	■	□	□	□	■	□
Event alarm	■	■	■	□	■	■	■
Buzzes within other applications	■	■	■	N/A	□	■	■
Weekly view	■	■	□	□	■	■	■
Monthly view	□	■	■	■	■	■	■
Yearly view	□	□	□	□	□	■	■
To-do list	■	■	■	■	■	■	□
User can assign priority levels to tasks	□	■	■	□	■	■	N/A
User can attach notes to tasks	■	■	■	■	■	■	N/A
Carries undone tasks forward	□	■	□	□	■	■	N/A
Word Processing							
Links to external word processor	■	■	■	□	■	■	■
Integrated word processor	■	■	■	■	■	■	■
Spell-checker	■	■	■	□	■	■	□
Integrated mail-merge/letter generator	■	■	■	■	■	■	□
Imports boilerplate text	■	■	■	■	■	■	■
Prints envelopes	■	■	■	■	■	□	■
Prints labels	■	■	■	■	■	■	■
Links to external fax software	□	■	■	■	□	□	□
Internal fax capability	■	□	■	□	□	□	□
Can fax boilerplate text	■	N/A	□	N/A	N/A	N/A	N/A
Can delay transmission	■	N/A	□	N/A	N/A	N/A	N/A
Can queue for multiple faxing	■	N/A	■	N/A	N/A	N/A	N/A
Reports and Utilities							
Number of predefined reports	9	9	30	18	26	19	16
Maximum number of user-defined reports	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	200	Unlimited
Can produce column math in reports	■	■	□	■	■	■	□
Expense tracker	■	□	■	□	■	■	■
Macro facility	■	■	□	■	■	■	□
Backup/restore facility	■	■	■	□	■	■	■
Calculator	■	□	■	■	■	■	□
Security/Help							
Password security	■	■	■	■	■	□	□
Context-sensitive help	■	■	■	■	■	■	■
Portability							
Links to hand-held computers	■	■	□	□	□	□	□
Hard disk space required	2MB	2.5MB	8MB	2.5MB	3.5MB	6MB	2.6MB
RAM requirements	640K	3MB	640K	640K	510K	2MB	640K
Can function as TSR	□	□	■	□	□	□	□

N/A—Not applicable: The product does not have this feature

SOFTWARE
Contact Management

ENDS



	GoldMine	In-Control	Instant-Office	Maximizer Advanced	Maximizer for Windows	PowerLeads!	SmartOffice	SuperOffice	SuperTime
	☐	☐	☐	☒	☒	☐	☒	☒	☐
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	☐	N/A	☐	☐	☒	☒	☒	☐	☒
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	☒	☒	☒	N/A	N/A	N/A	☐	N/A	N/A
	26	45	2	20	20	74	13	25	44
	Unlimited	12	3,000	Unlimited	Unlimited	Unlimited	Unlimited	N/A	N/A
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	2MB	1MB	840K	1.8MB	2.5MB	2MB	3.8MB-5.5MB	1MB	5MB
	470K	640K	256K	512K	2MB	2MB	512K	2MB	500K
	☒	☐	☐	☐	☐	☐	☐	☐	☒

Contact Management

Pyramid Data Inc.

PowerLeads!

BY LORI GRUNIN

Like a Shaker chair, PowerLeads! is simple, unadorned, and functional. Pyramid Data's \$295 product, the least complex of the Windows-based products in this roundup, is an easy-to-use and easy-to-understand tool for performing the essential functions of contact management.

All operations within PowerLeads! revolve around the well-designed main screen, which contains fields for all important contact information. (A minimalist List view provides only contact name and company data.) Clicking on the

SUITABILITY TO TASK

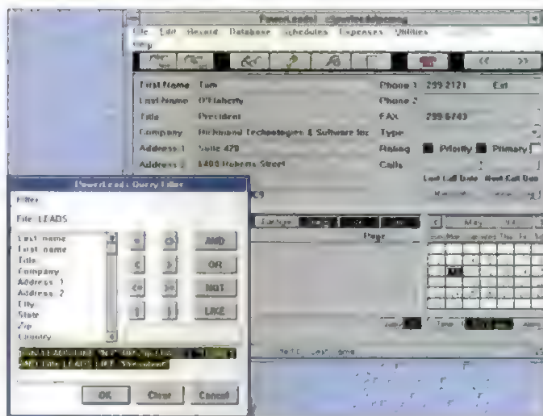
PowerLeads!

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	●	●	○
Correspondence	●	●	○	○
Extensibility	●	●	○	○

More Info button brings up a dialog comprising user-customizable fields and check boxes. If you want, however, you can also change the field labels on the main screen, and you can change the contents of all drop-down lists as well.

A Contact Log button opens up a form for entering relevant information (it also appears when using the auto-dial feature). Data from the log is placed in the on-screen Note field and maintained in a separate file for querying. From the calendar, you can bring up the Daily Agenda, which lets you branch into a view of your weekly schedule or to-do list. You can also enter and track expenses. All of these various dialogs flow in a logical fashion; in other words, there is little unnecessary jumping around.

For the most part, searches are as easy as data entry. You can do lookups across any of three indexed fields—First Name, Last Name, and Company Name—and run keyword searches across the Notes field. You can also create Boolean queries across any combination of fields in the data file. But you can't create Boolean queries across the Notes field.



Beneath the simple exterior of PowerLeads! beats the heart of a database.

WHAT IT IS

PowerLeads! is actually a runtime Superbase application, which is the source of both its strengths and weaknesses. For instance, the company claims that the relational engine lets the program handle a much larger number of contacts than other packages without suffering performance degradation. And during data import, PowerLeads! lets you match the contents of the fields in the incoming database with those in the current database ("Kennedy," for example, would be matched with the Last Name field). Unfortunately, you can't save the

▶ FACT FILE

PowerLeads!

Pyramid Data Inc., 1650 S. Amphlett Blvd.,
#212, San Mateo, CA 94402; 415-312-7070;
fax, 415-312-9374



List price: \$295.

Requires: 2MB of RAM, 2MB of hard disk space, VGA monitor, Microsoft Windows 3.0 or later.

In short: PowerLeads!, a runtime Superbase application, is a

straightforward, no-frills contact manager designed to handle large numbers of contacts rather than complex interactions among them. An easy-to-use and easy-to-understand tool, this low-cost Windows-based product should fill the bill for users who prefer to avoid the more complicated programs such as ACT! and Maximizer. Support for Microsoft Windows for Workgroups is planned for the next version.

ON READER SERVICE CARD

field matches as a template, and fields longer than the prescribed limits are automatically truncated.

The program does only the most basic job at reconciling duplicate entries; if a record matches on all three of the indexed fields, you can either skip the record or overwrite the current one. It would be nice if you could view the two records before making the decision. The current version of PowerLeads! is clearly not intended for use by multiple users (it performs file-locking instead of record-locking), and portability means making a copy of the database to put on your laptop and locking the one on your desktop against changes. Version

2.0, which was scheduled to go into beta testing as of this writing, will have enhanced workgroup capabilities and network support.

PowerLeads! could use a lot more sanding on some of its rough edges. Namely, it could insulate the user a bit more from its database origins.

2.0, which was scheduled to go into beta testing as of this writing, will have enhanced workgroup capabilities and network support.

NO BUFFER

PowerLeads! could use a lot more sanding on some of its rough edges. Namely, it could insulate the user a bit more from its database origins. For instance, you can use the variety of canned reports the program offers, or you can generate reports containing virtually any combination of fields; creating custom reports, however, means navigating a report writer that uses syntax such as "IT ON @1& 34,Company.LEADS" for its formatting commands.

Of the several trivial but irritating quirks, perhaps the most productivity-

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WordPerfect

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Publisher: Media Graphics International
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Manufacturer: US Robotics
Model: M12700

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Publisher: Software Marketing
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CM0590

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MM2130	◆ VFP V.32 BIS Int. 14400 S/R FAX Int	194.95

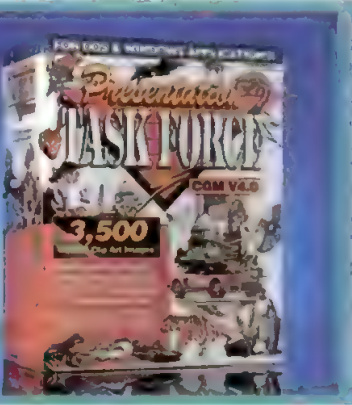
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SOFTWARE

Contact Management

impairing one occurs when using custom fields. *Customizing* really means changing the field label rather than the field name in the database structure. Therefore, when entering a query across a field you've named, say, "Exchange," you have to remember that it is really "User_Field_1." And the fixed-resolution screens may annoy some users.

Furthermore, while the package is relatively easy to learn and use, it still needs better support than the abysmal, minimalist on-line help that can't be called up from anywhere but the main screen. Moreover, its documentation is decidedly insufficient.

Overall, this package's no-frills approach to contact management certainly works and should be of particular appeal to Windows users who find products such as Act! for Windows and Maximizer for Windows to be functional overkill.

E-Z Data Inc.

SmartOffice

BY KATHY YAKAL

Though SmartOffice is a perfectly capable contact manager, the extras that E-Z Data has built into this \$595 package—invoicing and expense-tracking, a link to MCI Mail, and highly customizable second-level contact screens—don't justify its unusually high price tag. The company offers add-on modules—such as telemarketing and auto-action, which integrate seamlessly into the core product—but these, too, are quite pricey, as is technical support.

WHERE TO BEGIN

Unlike most other products, the contact screen is not the center of operations for SmartOffice. The opening screen consists of three boxed menus; in some cases, you must return to that screen by hitting Escape in order to get to any other part of the program. This awkward navigation—combined with the facts that its interface design does not follow CUA standards and its screens are not particularly attractive—may be unacceptable for users accustomed to state-of-the-art user interfaces.



The pop-up menu in SmartOffice's contact data-entry screen lists action options.

Nonetheless, the program's contact management abilities are among the best here. Two customizable layout options are available for contact data entry, and you can design a second screen when necessary. You can import and export data in ASCII, or export in dBASE format or via a direct link to the Sharp Wizard.

SmartOffice utilizes a combination of function keys and keystrokes for data entry and retrieval. For example, F1 accesses modifiable on-line help; F3 accesses a selected phone number, starting a timer; and F4 and F5 access search functions—simple field-based, as well as the more complex Boolean searches. You can use other keys to access the notepad, bring up the activity dialog box, or trigger standard functions such as adding or modifying a contact and generating a letter or invoice.

SUITABILITY TO TASK				
SmartOffice				
	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	●	○
Scheduling	●	●	●	○
Correspondence	●	●	●	●
Extensibility	●	●	●	○

Network users will appreciate the fact that notes and appointments are automatically tagged with the name of the person who entered them.

All events (correspondence, e-mail, phone calls, and so on) are recorded in the activity log, and meetings and tasks go into the scheduling area. You therefore have easy access to past histories and calendars (both daily and weekly views). All tasks can be tied to specific contacts, and unfinished tasks are carried over until they're marked as completed.

SmartOffice's built-in word processor is unusually flexible. It can mimic the command structure of several word processing products, including Microsoft Word, WordPerfect, and WordStar. Or you can import form letters created in an external application. Letters are created and printed out directly from the contact screen, but mailmerges are generated through the reporting function. You can also fax documents through SmartOffice if you have a CAS- or FaxBios-compatible fax board.

SmartOffice offers 13 predefined—and an unlimited number of user-defined—reports, though you can only change fonts through your printer, and only a minimal number of formatting commands are supported. Printing through your external word processor solves this problem.

E-Z Data offers a more affordable (\$199) version of SmartOffice called E-Z Track, which began shipping in late May. This package contains a subset of the features found in SmartOffice. Unless you need access to the modules that integrate with SmartOffice, E-Z Track would be the better choice for reasonably priced, customizable contact management.

Network users will appreciate the fact that notes and appointments in SmartOffice are automatically tagged with the name of the person who entered them.

SOFTWARE
Contact Management

FACT FILE

SmartOffice

E-Z Data Inc.,

533 S. Atlantic Blvd., Monterey Park, CA
91754; 800-777-9188; fax, 818-458-9097

List price: \$595.

Requires: 512K RAM, 3.8MB to 5.5MB hard disk space, DOS 2.1 or later.

In short: SmartOffice goes beyond simple contact management, providing tools for func-

tions such as telemarketing and invoicing. While its contact management features rival those found in some of the best products in this category, its user interface may put off users accustomed to state-of-the-art software design. Navigation is awkward in places, too. Still, it's flexible and powerful, particularly in areas such as searching for and grouping contacts, and reporting. It's also highly customizable. A new version that offers contact management without the extra modules began shipping in late May.

 ON READER SERVICE CARD

SuperOffice Corp.

SuperOffice

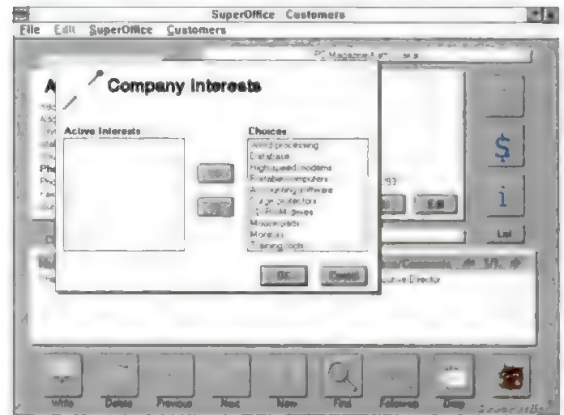
BY KATHY YAKAL

An attractive user interface and easy connectivity to outside applications are critical components of contact managers. SuperOffice, Version 2.5c (\$395), excels in both of these areas, though it doesn't offer the depth of features provided by the other contact managers we reviewed in this price range.

The Windows-based SuperOffice offers easy links to other software. These are not DDE (Dynamic Data Exchange) links; they simply allow you to launch other applications from the program. Icons are provided for word processing, spreadsheets, accounting, presentation graphics, e-mail, desktop publishing, and order entry.

The program's main working screens are attractive and uncluttered. You flip back and forth between the Customer screen (where contact data is entered) and the Diary screen (which shows your daily calendar and to-do list). Icons running along the side and bottom give you access to features such as the Notes field, auto-dialing, and history screens.

You can import a data file into SuperOffice in ASCII format (or any delimited



SuperOffice lets you assign customers to user-defined interest categories.

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ADVICE.



April 27, 1993
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PC World, Nov. '92



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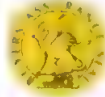
W. S. Mossberg,
Wall Street Journal, Oct. '92

"Those looking to add high-fidelity sound to their multimedia presentations should be pleased with this board's capabilities."

J. Quain, *PC Magazine*,
Sept. '92



Best Peripheral 1992
Pro AudioSpectrum 16



SOFTWARE

Contact Management

format); a nice field-mapping feature is included to ease this process. Unfortunately, you can't import in .DBF format, and you can't create more than one database.

To add a contact in SuperOffice, you type data into fields on the Customer screen. While there is room on the form to accommodate up to 50 alternative contacts per company, there are very few predefined and user-defined fields for entering data that is contact-specific.

SuperOffice keeps an ongoing history of your interaction, logging phone calls, meetings, and other notes and tasks, and reminding you when it's time to follow up with a contact.

SUITABILITY TO TASK

SuperOffice

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	○	○
Scheduling	●	●	○	○
Correspondence	●	○	○	○
Extensibility	●	●	●	○

Besides letting you run the simple search routines you'd expect from this kind of software ("Find all the customers in Texas," for example), as well the more complex Boolean searches, SuperOffice lets you categorize contacts by interests. Tag all of your contacts interested in word processing, for example, and you

SuperOffice doesn't offer the same depth of features as other contact managers.

can quickly generate a mailing list when you have a new product ready.

OFFICE ASSIST

You can easily schedule any kind of event. Click the New button at the bottom of the Diary screen, select the contact name and the type of event (outgoing call, meeting, task, and so on) from the

FACT FILE

SuperOffice, Version 2.5c

SuperOffice Corp., 130 Great Rd.,
Bedford, MA 01730; 617-275-2140;
fax, 617-275-6921



List price: \$395.

Requires: 2MB RAM, 1MB hard disk space, VGA monitor, Microsoft Windows 3.0 or later.

In short: SuperOffice, Version 2.5c, is less competent than some of its competitors. Its im-

port and export functions are limited, and its contact data screen and task-management abilities are inflexible. Still, it offers a clean, attractive design, which makes the program easy to understand and use. The Interests feature, for example, lets you group contacts by commonalities, letting you go beyond standard searches by contact fields. Users who work in several applications during the day will appreciate the links to other programs.



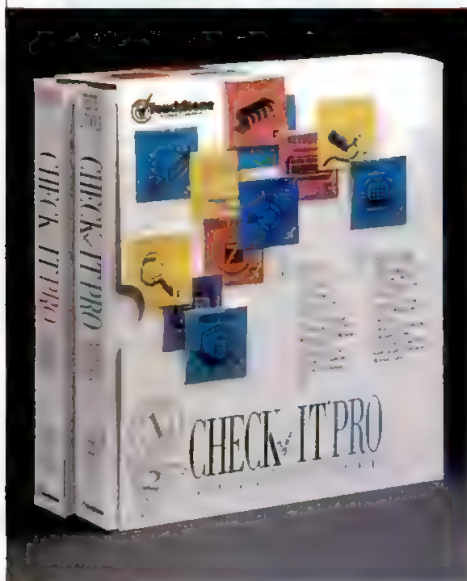
ON READER SERVICE CARD

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CIRCLE 004 ON READER SERVICE CARD

Contact Management

drop-down lists in the pop-up dialog box, and enter the pertinent details. Unfinished items roll forward until they are marked as done and then move into the history log.

All scheduled items appear in chronological order at the bottom of the Diary screen, and meetings are displayed on the daily calendar above the list. No alternative views of the calendar (weekly or monthly) are available, and tasks cannot be prioritized.

SuperOffice provides easy links to outside applications such as word processors, fax software, and e-mail programs, but add-on modules must be purchased from SuperOffice Corp. if you want to use those links optimally.

Twenty-five predefined report options are included, though user-defined reports require a \$99 add-on from the company. SuperOffice runs on peer-to-peer and server-based LANs. The application takes up only 1MB of hard disk space, making it truly portable.

If you need highly detailed, customizable contact screens and integrated word processing and fax capabilities, SuperOffice may not be your best choice. But for basic, competent contact management with a good-looking, easy-to-navigate user interface, this package might be worth your consideration.

SuperTime Inc.

SuperTime

BY GREGG KEIZER

Packed with groupware features, the \$295 SuperTime is suited more for group use than standalone use and works best as an office contact-management control center.

This DOS package, which sells for \$695 in a four-user configuration, combines basic contact management tools with such things as private databases, internal e-mail, and sophisticated group



SuperTime ranks an unlimited number of contacts under any company and then lets you define profiles for each contact.

scheduling, making it particularly attractive for offices full of salespeople.

A difficult installation (you must use DOS's LOADFIX command on machines running DOS 5.0 or later) mars an otherwise trouble-free configuration process of setting up users and importing contact data.

TIME AFTER TIME

Navigating through SuperTime is no snap. Though the menu system quickly gets you to the program's main sections, moving through the contact database itself is wearisome. Once the contact list is up, for instance, you can't simply type part of a name to reach a contact; you must use a secondary search function instead. And since disk access is almost constant when perusing the database, you'll spend long moments waiting for the program to find, and then display, a name or appointment.

Organizing contacts is much easier. SuperTime uses a company/contact approach to rank people under organizations, much like the approach the Maximizer packages employ. It also lets you add a profile consisting of user-defined classifications for a contact. These classifications, which come

in alphanumeric, date, numeric, and yes/no logical forms, let you build queries for ad hoc grouping of contacts in SuperTime's searches and reports. Such queries can be saved and reused.

SUITABILITY TO TASK

SuperTime

	POOR	FAIR	GOOD	EXCELLENT
Contact database	●	●	○	○
Scheduling	●	●	●	○
Correspondence	●	●	○	○
Extensibility	●	●	●	○

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April 27, 1993

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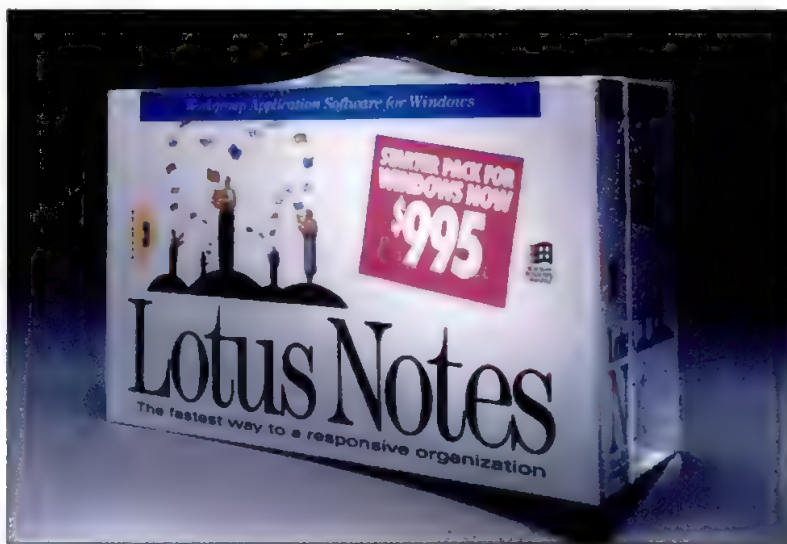


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Contact Management

SUPER SCHEDULE

Basic scheduling in SuperTime includes phone calls, appointments, meetings, and recurring events; a to-do list is also available. Activities, whether completed or not, are automatically logged to a contact's history. Up to six screens of notes can be entered, though time/date stamping of such notes isn't automatic.

SuperTime's groupware features are more impressive. An internal e-mail system combines with a digital message board to notify users on the network of upcoming meetings, allow memos to be filed electronically, and let people on the network post incoming phone messages to other users.

Efficient communications with contacts outside the office is more problematic, however. SuperTime's internal text tool is weak, lacking such basic features as boldfacing and margin settings. It's capable of churning out a quick form letter, but nothing more. Likewise, though the program includes an auto-dialer, it does not dial numbers from the primary contact screen. Instead, you must search

FACT FILE

SuperTime

SuperTime Inc.,

225 E. Beaver Creek Rd., #230, Richmond Hill, Ontario, Canada L4B 3P4;
416-764-3530; fax, 416-764-3536



List price: \$295.

Requires: 512K RAM, 6MB hard disk space, DOS 3.3 or later.

In short: SuperTime won't appeal to the single user eager for contact management help, but it may to anyone setting up a contact

system in a networked office. Its integrated e-mail and phone messaging center make it easy for users sharing a general contact database to stay in touch and schedule groupwide meetings. Unfortunately, however, SuperTime is somewhat difficult to navigate and slow to locate contacts; it also lacks several important contact components, such as a strong text tool. Overall, it's worth considering only if you want to tie multiple users to an officewide contact management system.



ON READER SERVICE CARD

through a list of all contacts before dialing or use the call list, which requires returning to the main menu and calling up that module.

SuperTime includes a variety of reports, which list contact activity, publish upcoming calls or appointments, and print contact notes. You must create and save the appropriate queries before building a report, however.

As you'd expect, SuperTime's network support is strong. A general database is shared among all users, but private databases can be secured from others' views.

An update to SuperTime failed to make the cutoff date for this article. We did, however, see a beta with an improved query system. Unfortunately, though, it looks like even better query tools won't turn this package into a functional single-user contact manager. Like Action+Plus—The Executive Power Tool, SuperTime is worth considering only if you want to tie multiple users to an officewide contact management system. □

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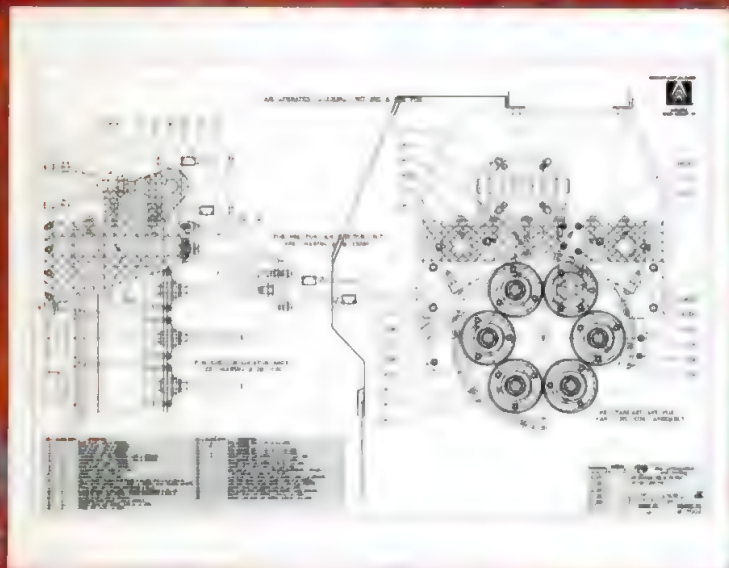


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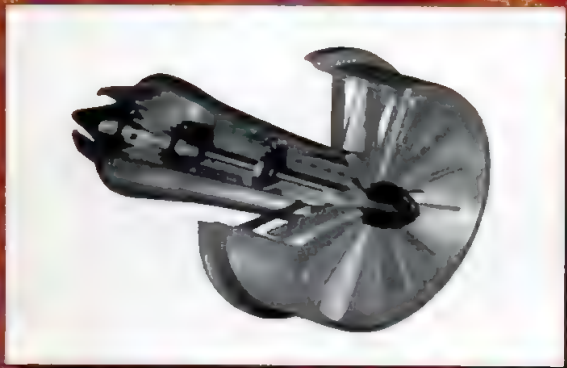
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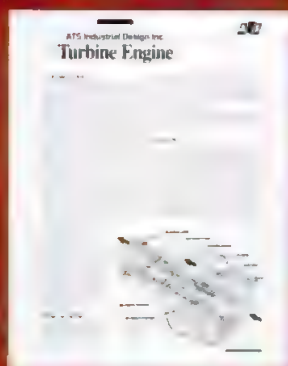
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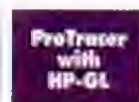
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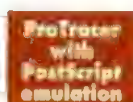
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PORTABLE PRINTERS

Steppin'
Out

by Lori Grunin

If I can just wait six more months, there will be a model that's faster/lighter/cheaper.

The six-month obsolescence dilemma is a fact of life for anyone who wants to buy a portable PC, but if you're in the market for a portable printer, there is less need to keep an eye on the horizon. This year's portable printer offerings are remarkably similar to last year's, with their under-9-pound weights and quality text output. In fact, the market has changed so little that the Editors' Choice winners from our last look at portable printers ("Small, Light, and Capable," *PC Magazine*, August 1992)—the \$469 Citizen PN48 Notebook Printer and the \$479 Kodak Diconix 701 Printer—remain strong contenders.

Just because the products are relatively similar to those from last year doesn't mean that the market is standing still. According to BIS Strategic Decisions, a research firm based in Norwell, Massachusetts, sales of under-10-pound printers with a battery

For output while you're on the road or just to save some space on your desktop, these six portable printers deliver quality output for an affordable low price.

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option have grown from 250,000 units in 1991 to 395,000 units in 1992, with a projected 1 million units for 1997. These figures take into account users who need portable printing and those interested in a space-saving, inexpensive desktop unit.

One recent change in the portable printer market is Hewlett-Packard's and Lexmark's entrance into the market, though even the addition of these two major printer vendors has caused ripples, not waves. HP offers its new \$479 HP DeskJet Portable Printer. Lexmark's \$449 IBM Portable Printer is a relabeled version of the aforementioned Citizen PN48; the \$449 IBM 4070 IJ strongly resembles the best-selling, \$349 Canon BJ-10ex Bubble Jet Printer.

Two interesting additions to the market—particularly for power notebook users—are the new printers from Mannesmann Tally: the MobileWriter and the MobileWriterPS. At \$875 and \$999, respectively, neither one of these is bargain-priced, and at 8.5 pounds each, neither is particularly travel-ready. But the MobileWriterPS is your only choice for portable PostScript printing; the HP PCL-equipped MobileWriter replaces the Mannesmann Tally MT735. With each producing around 6 pages per minute (ppm) of text in PCL mode, the MobileWriters can match a desktop laser's speed and handle downloadable macros for fast forms printing.

REVIEW CRITERIA

To be eligible for this review, printers had to weigh less than 10 pounds each with a sheet feeder or support a battery option; all six do both. Eligible printers also had to be new on the market or substantially changed since our August 1992 story. Only five printers met all our review criteria: the printer from HP, the two from Lexmark, and the two from Mannesmann Tally. We included the Kodak Diconix 701 Printer because it is a past Editors' Choice winner. We did not bring back the Editors' Choice-winning Citizen PN48, however, since the IBM

TO MEET OUR FILTER, each of these six portable printers had to weigh less than 10 pounds with a cut-sheet feeder or support a battery option; all six meet both requirements. The weights range from 2.5 pounds (the IBM Portable Printer) to 8.5 pounds (the MobileWriter and MobileWriterPS). We included the Kodak Diconix 701 Printer because it's a previous Editors' Choice winner, but we did not bring back the Editors' Choice-winning Citizen PN48 Notebook Printer, since the IBM Portable is essentially identical to that unit.

OF THE SIX PRINTERS we tested, three are ink jet units (the Diconix, HP DeskJet Portable, and IBM 4070 IJ), one is a thermal fusion unit (the IBM Portable) and two are thermal carbon-transfer printers (the MobileWriter and MobileWriterPS).

Portable is essentially identical to it.

Even though only six printers constitute our field, they represent a broad spectrum of designs. Three technology categories are represented: ink jet (the Diconix, the HP DeskJet Portable, and the IBM 4070), thermal fusion (the IBM Portable), and thermal carbon transfer (the MobileWriters).

Relative text printing speeds tend to depend on technology type. The IBM Portable was the slowest on our tests and the MobileWriters the fastest. The Diconix and HP DeskJet Portable led the rest, all ink jets, on our Text Speed test in quality mode.

In character-printer graphics mode,

RELATIVE TEXT-PRINTING SPEEDS

tend to follow technology types. On our tests, the IBM Portable was the slowest, the MobileWriters the fastest, and the rest—all ink jet printers—produced from 42 to 51 cps on our Text Speed test in quality mode.

THE PRINTING COSTS for these units range from the DeskJet's 4 cents per page and the Diconix's 5 cents per page to the IBM Portable's 44 cents per page.

FOR PCL AND POSTSCRIPT printing on the road, consider Mannesmann Tally's \$999 MobileWriterPS; the \$875 MobileWriter delivers HP PCL only. Each of these units cranks out 6 text pages per minute in PCL mode. But these units are also heavy (8.5 pounds each) and cost almost twice as much as each of their competitors.

top place went to the HP DeskJet Portable, which scored 1.7 graphics pages per minute (gppm). In PCL mode, the MobileWriterPS's graphics performance is double that of the MobileWriter (2.4 gppm versus 1.2 gppm), probably because it has twice the memory (2MB of RAM versus 1MB).

Speed isn't everything, though. Since these units will never be as essential as your portable computer, one extra pound can make the difference between taking the printer on the road and leaving it to collect dust. The IBM Portable is the most mobile, with its 3.1-pound *travel weight* (the printer's weight with a battery and an AC adapter). With 10.8-pound travel weights, the MobileWriters are only for those who own a car. The rest of these portable printers have a travel weight from 5 to 7 pounds.

HIGHLIGHTS Portable Printers

The printers reviewed here weigh less than 10 pounds each with a sheet feeder, and support a battery option.

Our Contributors: EDWARD MENDELSON is a contributing editor to *PC Magazine*. LORI GRUNIN is a former associate editor of and frequent contributor to *PC Magazine*. CATHERINE KUNKEMUELLER was the editor in charge of this story, and MICHAEL J. ZULICH was the project leader.

ALL-IN-ONE SOLUTION

If weight is of paramount concern to you, consider Canon Computer Systems' Canon NoteJet 486. This notebook computer has a built-in ink jet printer and a total travel weight of 7.7 pounds. (For more information, see the sidebar "Canon NoteJet 486: Hybrid Office" in this issue's story "The Portable Puzzle.") Another package designed to make traveling easier is O'Neil Product Development's Portable Workstation (714-727-1234). The Portable Workstation is a briefcase designed to hold the Kodak Diconix 180si Printer and AC adapter, with a 100-sheet paper-holding area that feeds directly into the printer. The Portable Workstation sells for \$594 with the printer or separately for \$259.

Canon's integrated ap-

proach results in a lower total weight to lug (7.7 pounds in all), but there is a price in terms of consumables. With the NoteJet, you pay more for consumables than with most of the standalone competition: 14 cents per page (assuming 2,500 characters per page, or cpp) versus around 10 cents or as low as 4 cents for the HP DeskJet Portable. Of the units we tested, the one with the highest price per page is the IBM Portable: a costly 44 cents per page with a single-strike ribbon.

DOUBLE DUTY: IN THE OFFICE

None of these portable printers can really serve as a full-time desktop printer, with the possible exception of the MobileWriters. But the majority of these units are qualified to do double duty as your home or office printer; here each unit's

print quality, supported media, and paper handling become issues.

Print quality can be an important distinction between your desktop printer and your portable printer. The output quality varies among these units, but they all prove adequate for printing draft documents to take to meetings or for proofing letters while traveling. If you want your unit to serve as your full-time printer, the ink jet models offer the best results on plain paper, though you'll still probably notice that their output quality differs somewhat from a laser printer's. The thermal carbon transfer-based MobileWriters also produce high-quality print but require better paper stock to attain it. The two IBM units produce the highest resolution: 360 dots per inch (dpi) versus the 300 dpi that the rest use.



EDITORS' CHOICE

• Kodak Diconix 701 Printer

Whether you need a printer that can be constantly on the move or one that can perform double-duty as a desktop unit, you should be able to find a suitable printer among these six contenders. The printer that stands out as the Editors' Choice winner has a familiar

face: The Kodak Diconix 701 Printer repeats the outstanding performance we saw last year.

The \$479 Diconix delivers foolproof paper-handling and high speed in addition to dark, crisp output. With the cover down, the unit measures 2.4 x 11.7 x 7.7 inches (HWD). It weighs 5.6 pounds without a battery and 6.8 pounds with a battery and AC adapter. With the paper-support wire extended, the printer holds 30 sheets of cut paper, proving itself equipped for moderate office work as well as use on the road.

The Diconix also showed its merit during PC Magazine Labs' testing. It was the fastest of the group when it printed text in draft mode, producing 64 cps; it tied the HP DeskJet Portable Printer for second-place by printing a solid 51 cps in quality mode (faster than the two IBM printers but one-third the

speed of the heavier and more expensive MobileWriter).

The Diconix is a little heavy for constant travel, but its output quality and speed—and its low, \$329 street price—make it an excellent choice.

HONORABLE MENTION

With its solid performance and output, Hewlett-Packard's \$479 HP DeskJet Portable Printer deserves an honorable mention. The DeskJet Portable tied with the Diconix on our Text Speed test in quality mode, and it turned in a highly impressive Graphics Speed score of 1.7 gppm. The DeskJet Portable also has a lower per-page cost than the Diconix (4 cents a page and 5 cents a page, respectively). Its travel weight is comparable with the Diconix's (4.7 pounds with a battery and no sheet feeder), and its street price is slightly

higher: \$385 without the sheet feeder.

The DeskJet Portable's Achilles heel, however, is its paper feeder. At 3.1 pounds, the \$99 cut-sheet feeder is heavy enough to qualify as a stay-at-home option. And although the DeskJet Portable has earned an honorable mention for its design (it won a 1993 Industrial Design Excellence Award, for example), during our tests the sheet feeder did not work well: It misfed when the printer was unattended, which casts doubts as to the DeskJet Portable's office-readiness.

Another printer that falls shy of top marks this year is Lexmark's IBM Portable Printer, which is based on last year's Editors' Choice-winning Citizen PN48 Notebook Printer. Although the IBM Portable Printer delivers the same high-quality output as the Citizen, and its 2.5-pound weight with a battery makes this the lightest unit tested, we felt that the IBM Portable did not stand out from the competition the way the Citizen had the previous year. For instance, Mannesmann Tally's two new MobileWriters produce output quality comparable to the IBM Portable's, with the added benefit of PostScript, HP PCL, or both. And the IBM Portable still carries a stiff operating price of 44 cents per page.

Portable Printers

For anything but the smallest print jobs, you'll want a sheet feeder, and all of the units here offer one, except the IBM Portable. The Diconix and the MobileWriters have feeders built in, the IBM 4070 IJ Model 1 comes with an attachable feeder, and HP offers one as a \$99 option. Keep in mind, however, that the HP's feeder is too heavy and bulky for frequent traveling. While all of these printers can handle overhead transparencies, only the HP and the two IBM printers can print on envelopes.

In the future, you should expect portable printers to follow the laptop route, becoming smaller, lighter, and less expensive. But in the meantime, with typical street prices below \$400, most of the units in this roundup nimbly and cost-effectively navigate between the office and the hotel room.

Hewlett-Packard Co.

HP DeskJet Portable Printer

BY LORI GRUNIN

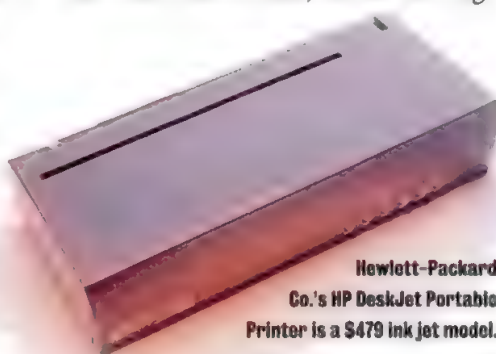
Its name notwithstanding, the HP DeskJet Portable Printer bears little physical resemblance to any of its DeskJet siblings, but Hewlett-Packard has managed to squeeze the same high-quality output from this sleek, compact, relatively lightweight model. The \$479 DeskJet Portable uses the same ink jet technology and standard DeskJet ink cartridges, and it speaks the same version of HP PCL 3 (with extensions) as the desktop printers.

The DeskJet Portable weighs 4.7 pounds with a battery and measures 2.5 by 12.3 by 5.8 inches (HWD) without the optional cut-sheet feeder, making it midrange for the units we tested. Individual sheets feed into the back of the unit and emerge through the front via a straight-through paper path.

This printer's setup and use is simple: Plug it in and print. Figuring out how to insert the optional \$49 nickel cadmium battery is a bit trickier, but installing it isn't difficult once you get the knack. The battery is rated to last about 100 pages, or a little over 3 hours. The four internal fonts are Courier, CG Times, Letter Gothic, and Univers. The DeskJet Port-

able ships with a selection of drivers, including those for popular DOS applications and Microsoft Windows 3.x.

The control panel on the top of the unit contains the usual indicator lights and form-feed buttons; the ink cartridge



Hewlett-Packard Co.'s HP DeskJet Portable Printer is a \$479 ink jet model.

loads easily via a drop-down panel in the front of the unit. Instead of flipping DIP switches to select options such as paper size or character set, however, you use the ink cartridge to point to menu items; the control-panel buttons move the ink cartridge back and forth among options.

At \$21.95 for a cartridge that outputs approximately 500 pages, the DeskJet Portable has the lowest print cost of any of the printers reviewed here: four cents per page.

FACT FILE

HP DeskJet Portable Printer

Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, Santa Clara, CA 95051; 800-752-0900; fax, 208-344-4809

List price: \$479 (includes AC adapter/charger, parallel cable, and one ink cartridge), 50-sheet cut-sheet feeder, \$99, nickel cadmium battery, \$49; rapid recharger, \$99, extra ink cartridge, \$21.95, carrying case, \$99

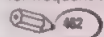
Requires: Parallel port.

Dimensions (HWD): 2.5 x 12.3 x 5.8 inches, 10 x 12.3 x 9.3 inches with cut-sheet feeder

Weight: 4.4 pounds, 4.7 pounds with battery, 5.7 pounds with battery and AC adapter

Emulations: HP PCL 3 with extensions

In short: The \$479 HP DeskJet Portable Printer uses the same ink jet technology as Hewlett-Packard's other DeskJet models and delivers similar-quality output, but it is light, weighing only 4.7 pounds with its battery. Unfortunately, the optional sheet feeder is too bulky for frequent travel.



ON READER SERVICE CARD

STRONG OUTPUT, SPEEDY PRINTING

In most respects, the DeskJet Portable is a formidable contender. It offers the same crisp, dark print quality as the rest of the DeskJet family, although shadow detail tends to get lost in graphics, and plain paper frequently becomes oversaturated (a problem with most ink jet output).

The DeskJet Portable is among the fastest performers we saw (though not quite as good as the MobileWriter). It tied with the Kodak Diconix 701 on the Text Speed test in quality mode (51 cps) and scored 57 cps on the Text Speed test in draft mode. Its impressive 1.7-gppm score on the Graphics Speed test even beat the MobileWriter. And at a street price near \$385, this printer is certainly competitive.

The \$99 optional cut-sheet feeder is more of a stay-at-home unit than the printer itself, however. The feeder measures 10 by 13 by 9.3 inches (with the paper-support arms extended); the paper emerges onto two spring-loaded paper-output guides. Unfortunately, the output guides don't support a stack containing more than two or three pages very well, and we found that we could not leave the unit unattended when printing. Weighing in at 3.1 pounds, the DeskJet Portable's feeder just isn't in the same league as the sturdy, built-in, no-extra-cost feeder of the Kodak Diconix 701.

As long as you don't frequently print multipage jobs, the DeskJet Portable will adequately fit your portable printing needs. Together with its attractive cost for consumables, this smallest member of the HP family has impressive output that makes it a strong contender.

Eastman Kodak Co.

Kodak Diconix 701 Printer

BY EDWARD MENDELSON

Eastman Kodak's \$479 Kodak Diconix 701 Printer won an Editors' Choice award the last time *PC Magazine* tested portable printers (August 1992), and it still ranks among the best of all portable printers. At 5.6 pounds without a battery, this ink jet printer weighs more than some notebook computers, but its fool-proof paper-handling, high speed, and



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CIRCLE 364 ON READER SERVICE CARD

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HARDWARE

Portable Printers

► SUMMARY OF FEATURES

Portable Printers

Products listed in alphabetical order

■ = YES □ = NO



	Eastman Kodak Diconix 701 Printer	HP DeskJet Portable Printer	IBM 4070 IJ Model 1	IBM Portable Printer	MobileWriter	MobileWriterPS
List price	\$479.00	\$479.00	\$449.00	\$449.00	\$875.00	\$999.00
Battery option	\$49.95	\$49.00	\$59.00	Included	Built-in	Built-in
Cut-sheet feeder	Built-in	\$99.00	Included	None	Built-in	Built-in

Physical Characteristics

Technology	Ink jet	Ink jet	Ink jet	Thermal fusion	Thermal carbon transfer	Thermal carbon transfer
Number of pins or jets	50	50	64	48	N/A*	N/A*
Maximum resolution (dpi)	300 x 300	300 x 300	360 x 360	360 x 360	300 x 300	300 x 300
Installed memory	24K	48K	37K	4K	1MB	2MB
Interface	Parallel	Parallel	Parallel	Parallel	Parallel	Parallel
Microsoft Windows driver	Included	Included	Included	Included	Via BBS	Via BBS
Weight (pounds, with battery)	5.9	4.7	7.7	2.5	8.5	8.5
Dimensions with cut-sheet feeder (HWD, in inches)	8.1 x 11.7 x 11.1	10 x 12.3 x 9.3	8.7 x 12.4 x 4.4	2 x 11.7 x 3.5 (no feeder)	9.5 x 11.3 x 8.5	9.5 x 11.3 x 8.5

Paper Handling

Type of paper feed	Pressure	Pressure	Pressure	Pressure	Pressure	Pressure
Paper paths	Rear U path	Straight-through	Bottom vertical, rear L path	Bottom vertical, rear U path	Rear U path	Rear U path
Rated maximum paper weight (pounds)	24	24	28	20 (bottom feed), 28 (rear feed)	24	24
Rated maximum paper width (inches)	8.5	8.5	9.7	9.6 (bottom feed), 10.2 (rear feed)	8.5	8.5
Media supported:						
Card stock	□	□	■	□	□	□
Transparencies	■	■	■	■	■	■
Envelopes	□	■	■	■	□	□
Landscape printing	■	■	□	□	■	■

Typefaces

Courier	■	■	■	■	■	■
Gothic	■	■	□	□	□	■
Prestige Elite	□	□	■	□	□	□
Sans serif	□	□	■	□	□	□
Other	Hevta	CG Times, Univers	Draft, Orator, Orator-S, Script, Times Roman	Roman	Dutch, Helv, Math8, Swiss	35 PostScript fonts

Control-Panel Buttons

Typeface	■	■	■	□	□	□
Emulations	■	□	■	□	□	□
Print mode	■	■	■	N/A**	N/A**	N/A**

Customer Support

Toll-free telephone technical support	■	□	□ (call-back policy)	□ (call-back policy)	■	■
Telephone support hours (eastern time)	8:00-8:00 M-F	10:00-9:00 M, T, Th, F; 10:00-7:00 W	10:00-7:00 M-F	10:00-7:00 M-F	10:30-7:30 M-F	10:30-7:30 M-F
BBS	□	■ (CompuServe)	■	■	■	■
Warranty	3 years	1 year	1 year	1 year	1 year	1 year

N/A*—Not applicable. In place of a moving printhead with pins or jets, this unit employs an 8.5-inch-wide printhead with 2,560 heating elements.

N/A**—Not applicable. This printer offers only one print mode.

The **NEW** under \$1000 TI microWriter PS23 is the best value in laser-quality PostScript printers.

23 Scalable PostScript typeface fonts in popular Adobe® PostScript® formats.

Crisp, *#Δ sharp graphics.

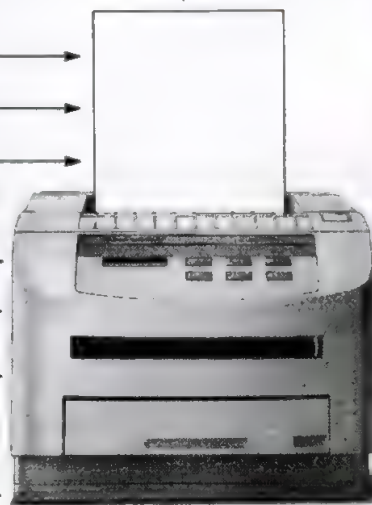
LED technology uses fewer **MOVing Parts** than conventional laser printers for great reliability.

Automatically switches between **PostScript** and **HP LASERJET® II** printing formats.

Easy to use front control panel.

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With available options, can handle up to **3** trays of paper, including envelopes and labels.



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CIRCLE 139 ON READER SERVICE CARD

Portable Printers

dark, clear output more than compensate for its weight.

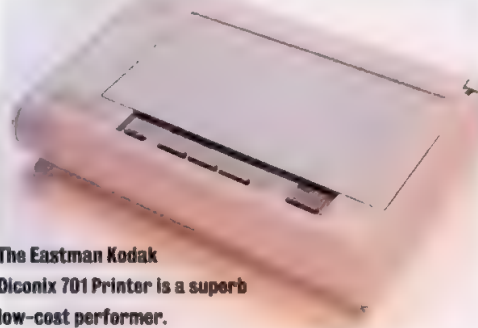
With the top canopy closed for traveling, the Diconix measures 2.4 x 11.7 x 7.7 inches (HWD). When you lift the canopy and fold out a paper-support wire, the printer can hold 30 cut sheets of paper; the Diconix then requires 8.1 inches vertically and 11.1 inches from front to rear. Just drop the paper into the feeder slot behind the platen, and the printer sends each sheet through a U-shaped path to an output stack on top of the feeder stack. It cannot print on envelopes, however.

After you've admired the Diconix 701's efficient paper-handling, you will probably be equally impressed with its speed. The printer scored 51 cps on the Text Speed test in quality mode (tying the HP DeskJet Portable for second place) and 64 cps in draft mode. On the Graphics Speed test, this unit delivered a respectable 1.1 gppm.

All the emulations—IBM Proprinter, X24E, HP PCL 3, and its native Kodak Diconix 701 mode—worked flawlessly. The 50-nozzle printhead produced crisp text and graphics output. During testing,

the ink smudged slightly when we wet the paper, though the problem was no worse than with the average ink jet printer. The Diconix produced mediocre results when printing on transparencies, though the company states that its special Diconix transparencies may fare better.

The resident fonts include Courier, Gothic, and a proportional Helvetica-style font called Hevta. When you print



The Eastman Kodak Diconix 701 Printer is a superb low-cost performer.

a status sheet, you see the full character set, a list of printer settings, and a meter showing how much ink is left in the cartridge. The interactive configuration system prints a menu on a sheet of ordinary paper and lets you move the printhead to point to the desired selection. The control panel is simple and uncluttered.

A 0.9-pound 110-volt AC power adapter ships with the printer. A standard 0.3-pound NP-55 camcorder battery pack such as the Sony NP-55 produces 100 text pages per 4.5-hour recharge; Kodak sells the battery for \$49.95. The total travel weight is 6.8 pounds. You receive one cartridge with the printer, and it pops effortlessly into place during installation. Replacement cartridges list for \$29.95 and are rated to produce 600 text pages at 2,500 cpp, so you can count on paying 5 cents per page for letter-quality text. Kodak also supplies a \$59.95 carrying case, and optional 220/240-volt, 50-Hz power adapters with plugs designed for United Kingdom (\$49.95) or continental Europe (\$29.95) currents.

With a street price around \$329, the Diconix is a superb low-cost performer. It's too heavy for casual globe-trotting, but if you aren't going to carry it in and out of airports twice a day, you will find that its output quality and convenience make this printer a perfect traveling companion.

Lexmark International Inc.

IBM 4070 IJ

IBM Portable Printer

BY EDWARD MENDELSON

Lexmark International's two portable printers produce beautiful output, and they're effortless to use, but you may have a hard time keeping track of who gets the credit for them. The \$449 IBM Portable Printer is a relabeled version of the Citizen PN48 Notebook Printer. The IBM 4070 IJ (\$449 with a cut-sheet feeder and \$399 without one) also carries the IBM logo, but it is virtually identical to the Canon BJ-10ex Bubble Jet Printer. Both the Citizen and Canon models are fine performers, and the Citizen won an Editors' Choice when we surveyed portable printers in 1992.

If you buy these units from Lexmark, you get the same performance, plus exceptionally lucid Lexmark-designed manuals, along with a one-year warranty that offers a free replacement by overnight express. The street price of the IBM Portable Printer and its Citizen counterpart are virtually the same; the street price of the IBM 4070 is about \$85 more than its Canon counterpart.

IBM 4070 IJ

The IBM 4070 IJ, a 360-dpi ink jet printer based on a 64-nozzle Canon engine, comes in two versions: the \$449 Model 1, which comes with a 50-sheet feeder, and the feederless Model 2. The \$399 Model 2 measures 2.1 x 12.4 x 8.7 inches and weighs 4 pounds without a battery. Both models come with a 0.6-pound AC adapter/charger and an ink cartridge. A 0.7-pound battery pack costs \$59 and has enough power to print 40 pages on each charge, which lasts 2 hours 20 minutes.

To print on ordinary paper without using the sheet feeder, you open the top canopy and feed individual sheets through a rear, L-shaped path, while the printer sits horizontally on its 12.4-by-8.7-inch lower panel. When you print with thick paper or envelopes, you stand the printer vertically on its narrow, 2.1-by-12.4-inch back edge and feed sheets through a slot on the lower panel.



FACT FILE

Kodak Diconix 701 Printer

Eastman Kodak Co., Desktop Imaging Div.,
901 Elmgrove Rd., Rochester, NY 14653;
800-344-0006; 716-724-4000

List price: \$479 (includes AC adapter and ink cartridge); nickel cadmium battery, \$49.95; foreign AC adapters, \$29.95 to \$49.95; extra ink cartridge, \$29.95, carrying case, \$59.95

Requires: Parallel port.

Dimensions (HWD): 2.4 x 11.7 x 7.7 inches, 8.1 x 11.7 x 11.1 inches with built-in cut-sheet feeder extended

Weight: 5.6 pounds, 5.9 pounds with battery, 6.8 pounds with battery and AC adapter

Emulations: IBM Proprinter, HP PCL 3, Diconix 701

In short: The \$479 Kodak Diconix 701, which earned itself an Editors' Choice distinction in our August 1992 issue, once again proves itself worthy of the honor. Crisp output, foolproof paper handling, and easy operation more than compensate for this ink jet printer's hefty, 6.8-pound travel weight



ON READER SERVICE CARD

When used as a character printer, the MobileWriter took top honors on our Text Speed test in quality mode, with the HP DeskJet Portable Printer and Kodak Diconix 701 Printer tying for second place. Among the character printers, the HP unit was first on our Graphics Speed test. In HP PCL printing, the MobileWriterPS had a slight edge over its sibling because of its extra 1MB of memory.

What the Numbers Mean

In character printer mode (as opposed to PCL or PostScript), the printers' performance on our Text Speed test in quality mode ranged from the IBM Portable Printer's 23 cps to the MobileWriter's 161 cps. The MobileWriter's 1MB of RAM helped it outperform the competition.

Of the three printers that can print text in draft mode (all ink jets), the Kodak Diconix 701 took top honors, at 64 cps. For most ink jet printers, draft mode is an ink-saving feature and provides only a small performance improvement.

In character printer graphics mode, the HP DeskJet Portable Printer scored 1.7 gppm. The MobileWriter placed a close second, at 1.6 gppm.

Although Word for Windows and CorelDRAW test results are a better measure of each printer's Microsoft Windows 3.1 driver than of the printer itself, faster printers still tend to perform the best on these tests. On our Word for Windows test, the MobileWriter was the fastest printer in character mode, producing our test document in 35 seconds. The Diconix required 5 minutes to print our test document, though on our DOS-level tests, its performance scores were similar to those produced by the HP DeskJet Portable; this indicates a poor Windows driver.

On our CorelDRAW test, the HP DeskJet Portable had the best performance, taking only 55 seconds to print our test image from within the application and a mere 38 seconds to print from a file. The IBM Portable placed at the bottom of the list, taking more than twice as long as the HP unit.

PCL AND POSTSCRIPT TEST RESULTS

On our HP PCL tests, the principle performance difference between the MobileWriter and the MobileWriterPS can be attributed to the amount of on-board memory: The MobileWriter came with 1MB of RAM, and the MobileWriterPS had 2MB.

In PCL text mode, both printers performed at nearly the same level, with the PCL-native MobileWriter slightly ahead of the MobileWriterPS (6.2 ppm versus 6.0 ppm, respectively). When in PostScript mode, the MobileWriterPS produced our test document at 4.5 ppm. This performance difference is entirely attributable to the overhead of PostScript printing.

In PCL graphics mode, however, the MobileWriterPS's 2MB of memory enabled it to produce our PCL test image twice as fast as the MobileWriter: 2.4 gppm versus the MobileWriter's 1.2 gppm. In PostScript mode, the MobileWriterPS produced a score of 0.4 gppm.

Applications performance under Word for Windows 2.0 shows little difference between the two printers in PCL mode, which is largely because of the amount of memory installed in each printer and the relatively small test file size. In CorelDRAW testing, however, the performance gap widens, again because of the amount of installed memory. In PostScript mode, the MobileWriterPS printed our Word for Windows test document in 1 minute 29 seconds, taking almost three times as long as it did in PCL mode, and it stumbled through the CorelDRAW test, taking 2 minutes 29 seconds for each procedure.

How We Tested

We used a Compaq Deskpro 486/33M equipped with 8MB of memory, a 310MB hard disk, Compaq DOS 5.0, and Microsoft Windows 3.1. Each printer ran a series of DOS-level tests for text and graphics speed, compatibility, and print quality (results shown in the Printer Guides). We also tested HP PCL- and PostScript-compatible printers for emulation compatibility. For PCL printers, we used PC Magazine Labs' PCL 4 and PCL 5 compatibility tests. For PCL 4 we looked at nested macros; for PCL 5 we looked at scalable fonts, orthogonal printing, HPGL, and PCL 5 compression modes 1, 2, 3, and 5.

We used a series of files, developed by Adobe Systems, to test PostScript compatibility by exercising the Level 1 and Level 2 functions. Level 1 printers used a complex image containing 1-bit-wide lines. Our Level 2 test included a compressed image using ASCII 85 encoding and the Lempel-Ziv-Welch (LZW) algorithm (which requires a Level 2 interpreter).

For Microsoft Windows 3.1 testing, we used CorelDRAW 3.0 and Word for Windows 2.0. We installed Windows, accepting all of its defaults, and set up a 19MB virtual-memory file and a 2K SmartDrive cache. We disabled the Windows print spooler.

The **Text Speed** test measures the time it takes to send and print one copy of a two-page business letter with 1-inch margins in 10-cpi type. The test is performed twice, once in draft mode and once in quality mode.

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created by using CorelDRAW and Microsoft Windows 3.1.

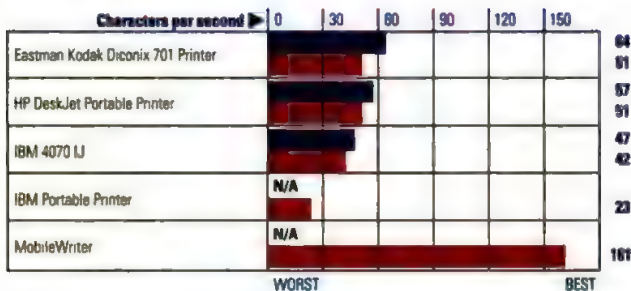
The **Word for Windows** test records the time required to print a two-page business report that uses multiple fonts and type styles. We conducted this test using the Microsoft Windows driver recommended by each printer manufacturer.

The **CorelDRAW** test measures the time required to print a CorelDRAW graphics file. The test consists of two procedures: a direct print from within the application (Direct Print) and a print of a pre-generated file external to the application (Print from File). It uses the same graphics file as the Graphics Speed test does. We conducted this test with the Microsoft Windows driver recommended by each printer manufacturer.

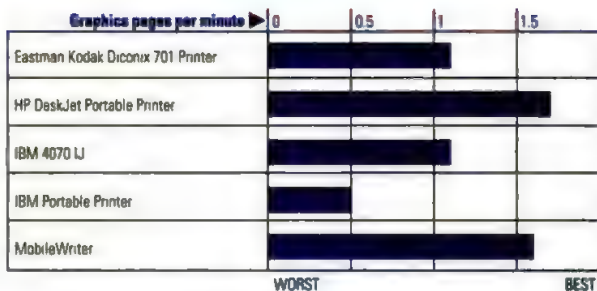
DOT MATRIX

Text Speed

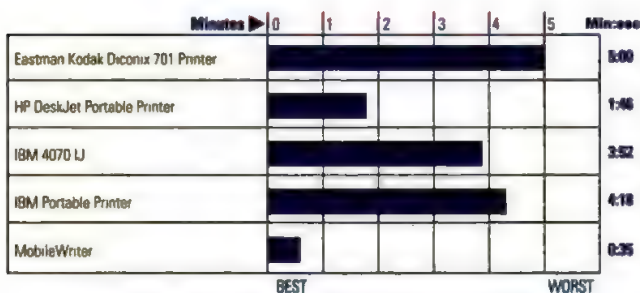
■ Draft ■ Quality



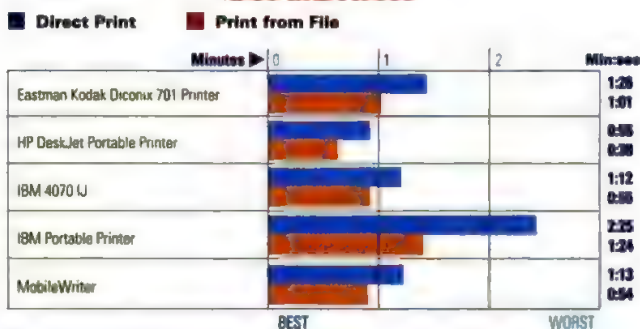
Graphics Speed



Word for Windows

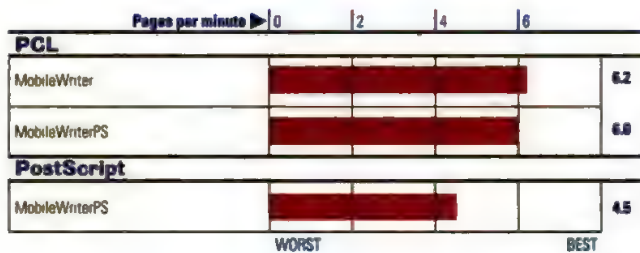


CorelDRAW

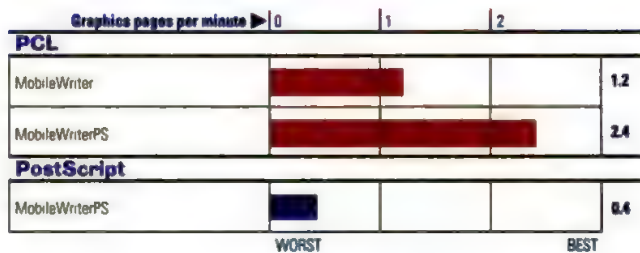


PCL/POSTSCRIPT

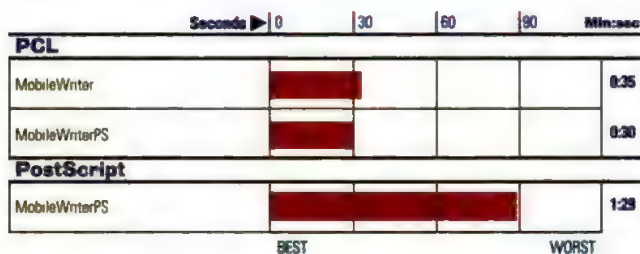
Text Speed



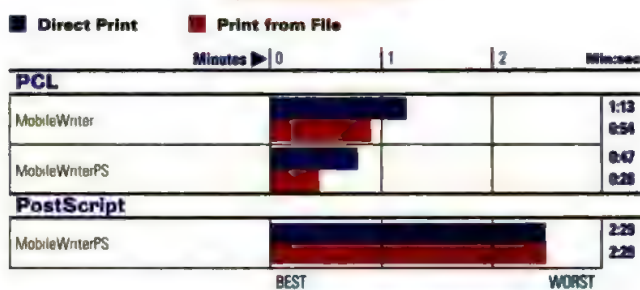
Graphics Speed



Word for Windows



CorelDRAW



N/A—Not applicable. The product could not perform this test.

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OF COMPANIES
CAN SELL YOU
A COMPUTER
THROUGH THE
MAIL.

BUT THERE'S ONE THAT CAN DE



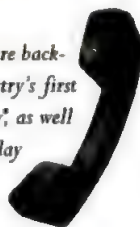
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A red menu cover with the word "MENU" in gold lettering. The cover has a textured, slightly worn appearance. The word "MENU" is centered and underlined. Below the word, there are some faint, illegible markings that appear to be "1944" and "1945".

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♦ Integrated QVision Graphics displays up to 256 colors at 1024 x 768 with 512-KB VRAM option** ♦ 3 expansion slots ♦ 3 internal storage device positions ♦ Security features ♦ Business Audio ♦ COMPAQ Color Monitor, preinstalled MS-DOS 6.0, Microsoft Windows 3.1 & Sound System Software, COMPAQ Mouse & Microphone.



COMPAQ DESKPRO 4/25is
25-MHz 486SX, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor. Delivers fast, high-resolution graphics in Windows.



COMPAQ DESKPRO 4/33i
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Contura Features

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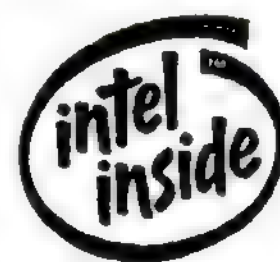
COMPAQ Contura 3/25
25-MHz 386SL, 4-MB RAM, 120-MB hard drive, monochrome VGA display, 6.2 lbs. An affordable notebook loaded with features.



COMPAQ Contura 4/25
25-MHz 486SL, 4-MB RAM, 120-MB hard drive, monochrome VGA display, 6.2 lbs. Upgradeable to Active Matrix Color Display.

ProLinea Features

3½" 1.44-MB diskette drive
♦ 1024 x 768 local bus video graphics with 1-MB VRAM in up to 256 colors (on 486 models) ♦ 3 expansion slots ♦ 3 internal storage device positions ♦ Security features ♦ COMPAQ Color Monitor, preinstalled MS-DOS 6.0 and Microsoft Windows 3.1 and a COMPAQ Mouse.



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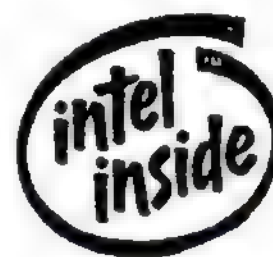


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Portable Printers

The \$449 Model 1 comes with a sheet feeder that you can leave behind or attach to the lower panel, making the combined thickness 6.5 inches with the feeder closed or 8.7 inches when the feeder is opened to hold paper. In this configuration, the printer weighs a hefty 7 pounds without a battery and stands vertically on its narrow back edge, as the feederless model does when you use envelopes or thick paper. With the automatic feeder attached, you feed envelopes and thick paper individually through a slot, the same way you do when the feeder isn't present. During testing, the IBM 4070 occasionally jammed when the sheet feeder grabbed two sheets instead of one.

If you buy the Model 2 and then decide you want the sheet feeder, you'll pay \$109 for the option. Each \$28 ink cartridge is rated at 700,000 characters (about 280 pages at 2,500 cpp), at a relatively steep cost of 10 cents per page.

The IBM 4070 comes with three emulations: IBM Proprinter X24E, Epson LQ-510, and Canon BJ-130 Bubble Jet Printer. You switch among them and change other configuration settings by pressing well-labeled DIP switches under the top cover. The control panel is remarkably simple. The available fonts are Orator, Orator-S, sans serif, and Times Roman (via the Epson emulation); Courier, Prestige Elite, and Script (via the IBM emulation); and an ink-saving draft.

The printer clocked in at 47 cps on our Text Speed test in draft mode and 42 cps in quality mode. The graphics speed, 1.1 gppm, is also respectable, particularly for a portable printer. Graphics printed in Proprinter mode were clear and regular; text in Epson mode was slightly marred by thin horizontal dropouts. If you need transparencies on the road, the IBM 4070 can print them well.

The printer's street price is about \$335, and the feeder adds about \$40. You can find the corresponding Canon BJ-10ex model for about \$250 without a feeder, and the Lexmark overnight-replacement warranty may not be worth the extra expenditure.

IBM PORTABLE PRINTER

The \$449 IBM Portable Printer, which weighs a mere 2 pounds without a battery and measures 2 x 11.7 x 3.5 inches (HWD), generates amazingly dark and clear 360-dpi output on paper and transparencies. It offers only two fonts (Roman and Courier), though, handles only one sheet at a time, and won't break any speed records.

The thermal-fusion printer comes with a 0.5-pound battery pack, a 0.6-pound AC adapter/charger, and a proprietary 0.3-pound parallel cable. The battery produces 25 pages from a six-hour charge; if you leave the battery behind, the total weight is only 2.9 pounds. A carrying case sells for \$35, but the printer probably fits in the same case with your portable computer.

Ordinary paper enters the printer's back panel and takes a U-shaped path past the printhead. Envelopes and thick paper feed vertically through a slot on the bottom.

The unit uses single- or multistrike ribbons; one of each comes in the box. If you use the multistrike ribbon, you probably won't need to carry spares, but if you prefer the single-strike, letter-quality ribbon, prepare to snap in a new one after printing 14 pages at 2,500 cpp. Both ribbon types cost \$30.50 for a box of five, so you'll pay a wallet-busting 44 cents per page for single-strike printing. Lexmark estimates that you'll pay 14 cents per page for printing with multistrike ribbons. (Per-page costs will be lower if you can find a discount on the ribbons.)

The Portable Printer emulates the Epson LQ-850 and the IBM Proprinter X24E. As with a laser printer, this unit offers only letter-quality text. On PC Labs' Text Speed test in quality mode,

FACT FILE

IBM 4070 IJ

List price: Model 1, \$449 (includes cut-sheet feeder, AC adapter, and ink cartridge); Model 2, \$399 (without feeder) Battery, \$59; AC adapters, \$45 to \$109, parallel cable, \$14, 50-sheet single-bin cut-sheet feeder, \$109, extra ink cartridge, \$28; carrying case, \$59

Requires: Parallel port

Dimensions (HWD): Model 1, 8.7 x 12.4 x 4.4, Model 2, 2.1 x 12.4 x 8.7 inches

Weight: Model 1: 7.0 pounds, 8.3 pounds with battery and AC adapter, Model 2: 4.0 pounds, 5.3 pounds with battery and AC adapter

Emulations: IBM Proprinter, Epson LQ, Canon BJ-130

In short: The \$449 IBM 4070 IJ has a hefty, 8.3-pound travel weight with its sheet feeder, but it delivers speedy, quality text output

IBM Portable Printer

List price: \$449 (includes battery, AC adapter, mini-parallel cable, two ribbons), low-voltage adapter, \$71, high-voltage line cord, \$12; 220-volt 50-Hz adapter, \$90, five-pack of ribbons (single-strike or multistrike), \$30.50; carrying case, \$35

Requires: Parallel port

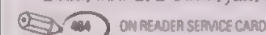
Dimensions (HWD): 2 x 11.7 x 3.5 inches

Weight: 2 pounds, 2.5 pounds with battery, 3.1 pounds with battery and AC adapter

Emulations: IBM Proprinter, Epson LQ

In short: Essentially the same as the Citizen PN48, the \$449 thermal-fusion IBM Portable Printer outputs quality text, but it is slow and lacks a sheet feeder.

Lexmark International Inc., 740 New Circle Rd., Lexington, KY 40511-1876; 800-438-2468, 606-232-3000; fax, 800-522-3422



the Portable Printer scored only 23 cps and produced a mere 0.5 gppm on our Graphics Speed test.

If you want quality printing on the road and you don't want to strain your arms to get it, this may be your printer. The street price of Lexmark's version is about the same as the Citizen counterpart, and Lexmark adds overnight replacement—something you may find valuable when you're traveling.

How to Read the Printer Guide

● Text Speed

Our standard Text Speed test uses a two-page business letter. We report the output speed in characters per second (cps).

Graphics output

The photo shows how well the printer reproduces halftones

Text output

This is a sample of each printer's fonts

Gray-scale output

This bar consists of six shades of gray

Line art

This shows how well the printers handle increasingly wide lines, as well as curves



Eastman Kodak Diconix 701 Printer

\$479
50-nozzle ink jet printer

Draft Text Speed: 64 cps
Quality Text Speed: 51 cps
Graphics Speed: 1.1 gppm

WINDOWS APPLICATIONS:
Word for Windows: 5 min. 0 sec.
CorelDRAW (Direct): 1 min. 26 sec.
CorelDRAW (File): 1 min. 01 sec.



Courier
Gothic



● Graphics Speed

The scanned photo doubles as an output sample and a part of our Graphics Speed test. We report the output speed in graphics pages per minute (gppm).

● Word for Windows

The Word for Windows test uses a two-page business report that includes multiple fonts and type styles. We report the output speed in characters per second (cps).

● CorelDRAW (Direct Print)

This Windows test involves a direct print from within CorelDRAW. We use the same graphics file as in the Graphics Speed test and report the output speed in graphics pages per minute (gppm).

● CorelDRAW (Print from File)

This version of the CorelDRAW test prints a pregenerated file external to the application. Again we report the output speed in gppm.

N/A—Not applicable: This printer does not have a draft mode.

HP DeskJet Portable Printer

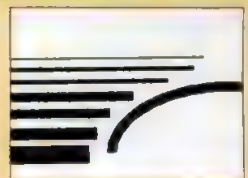
\$479
50-nozzle ink jet printer

Draft Text Speed: 57 cps
Quality Text Speed: 51 cps
Graphics Speed: 1.7 gppm

WINDOWS APPLICATIONS:
Word for Windows: 4 min. 46 sec.
CorelDRAW (Direct): 0 min. 50 sec.
CorelDRAW (File): 0 min. 38 sec.



Courier
CG Times
Letter Gothic
Univers

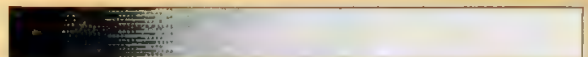


IBM Portable Printer

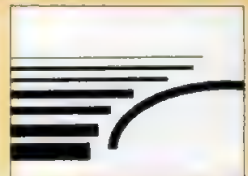
\$449
48-pin thermal fusion printer

Draft Text Speed: N/A
Quality Text Speed: 23 cps
Graphics Speed: 0.5 gppm

WINDOWS APPLICATIONS:
Word for Windows: 4 min. 18 sec.
CorelDRAW (Direct): 2 min. 25 sec.
CorelDRAW (File): 1 min. 24 sec.



Courier
Roman



IBM 4070 LJ

\$399
64-nozzle ink jet printer

Draft Text Speed: 47 cps
Quality Text Speed: 42 cps
Graphics Speed: 1.1 gppm

WINDOWS APPLICATIONS:
Word for Windows: 3 min. 52 sec.
CorelDRAW (Direct): 1 min. 12 sec.
CorelDRAW (File): 0 min. 55 sec.



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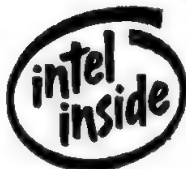
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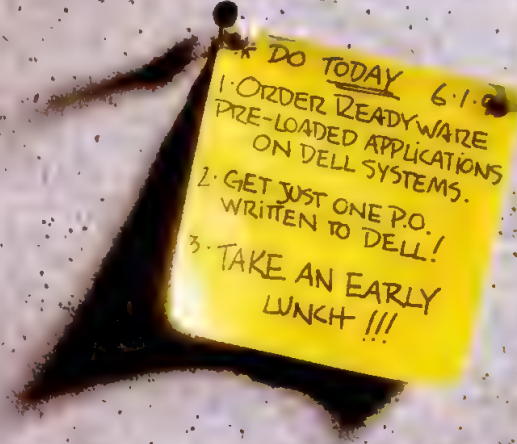
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HARDWARE

Portable Printers

MobileWriter

\$875

Thermal carbon-transfer printer

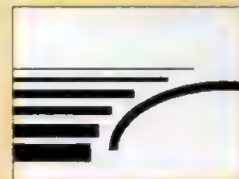
Draft Text Speed: N/A
Quality Text Speed: 161 cps
Graphics Speed: 1.6 gppm

PCL Text Speed: 6.2 ppm
PCL Graphics Speed: 1.2 gppm

PCL WINDOWS APPLICATIONS:
Word for Windows: 0 min. 35 sec
CorelDRAW (Direct): 1 min. 13 sec
CorelDRAW (File): 0 min. 54 sec



Courier
Dutch
Swiss



MobileWriterPS

\$999

Thermal carbon-transfer printer

PCL Text Speed: 6.0 ppm
PCL Graphics Speed: 2.4 gppm

PCL WINDOWS APPLICATIONS:
Word for Windows: 0 min. 30 sec
CorelDRAW (Direct): 0 min. 47 sec
CorelDRAW (File): 0 min. 26 sec

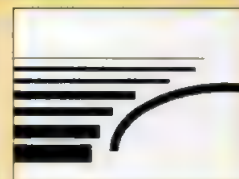
PS Text Speed: 4.5 ppm
PS Graphics Speed: 0.4 gppm

PS WINDOWS APPLICATIONS:
Word for Windows: 1 min. 29 sec
CorelDRAW (Direct): 2 min. 29 sec
CorelDRAW (File): 2 min. 29 sec



Avant Garde
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Courier
Helvetica

New Century School



Mannesmann Tally Corp.

MobileWriter

MobileWriterPS

BY LORI GRUNIN

At around twice the price and twice the weight of most of its competition, Mannesmann Tally's \$875 MobileWriter and \$999 MobileWriterPS would have to offer some pretty compelling reasons for you to buy them. But ease of use, speed, HP PCL 4, and PostScript (with the MobileWriterPS) are reason enough for some users to buy one of these printers.

The two 8.5-pound printers are identical in all but three ways. The MobileWriter's main language is PCL 4 with bitmapped versions of Dutch and Swiss fonts (the equivalent of an HP LaserJet II plus the HP Microsoft Z Cartridge). The MobileWriterPS printer offers Microsoft/Bauer PostScript Level 1 (with the accompanying high-quality 35 fonts) and PCL 4 modes, and it performs automatic emulation sensing and switching between the two modes. Second, the MobileWriterPS

offers a built-in AppleTalk port. The final difference is cosmetic: The MobileWriter's case is the industrial white that Intel-based PCs generally wear, while the MobileWriterPS is Apple PowerBook gray.

Measuring 2.3 by 11.3 by 8.5 inches without a sheet feeder, the MobileWriters look and feel like notebook PCs. Paper feeds into and emerges from the top of the unit. An exceptionally well-designed 80-sheet feeder is built into the unit (and extends the height to 9.5 inches when in use).

In addition to the usual front-panel functions, there is also a Print-Density switch (which controls the amount of ink

of juice. The AC adapter feeds in through the battery, so in order for the printer to run, the battery, which has a rated life of almost 3 hours, must have at least a minimal charge; it will trickle-charge as you work.

HIGH-SPEED PERFORMANCE

Both printers use a thermal carbon transfer technology that is similar to the thermal wax transfer method found in most inexpensive color PostScript printers (although these two output monochrome only). The paper and the ribbon simultaneously scroll over the printhead, which prints an entire line in a single pass. When combined with the advanced printer languages, the result is the fastest printing available for under 10 pounds: an average text speed of 175 cps in PCL mode for both printers (around 6 ppm), and 4.5 ppm for the MobileWriterPS in PostScript mode.

The MobileWriterPS garnered 2.4 gppm in PCL mode and 0.4 gppm in PostScript mode, while the MobileWriter scored 1.2 gppm in PCL mode.

At its best—on high-quality coated paper, such as the Nekoosa Laser 1000



Mannesmann Tally's
MobileWriter (left) and MobileWriterPS
are heavy, but both are loaded with features.

used) and a Copy button (which reprints the last page). The charge status of the built-in battery is available by printing the test page, though an indicator will blink when the battery starts running out

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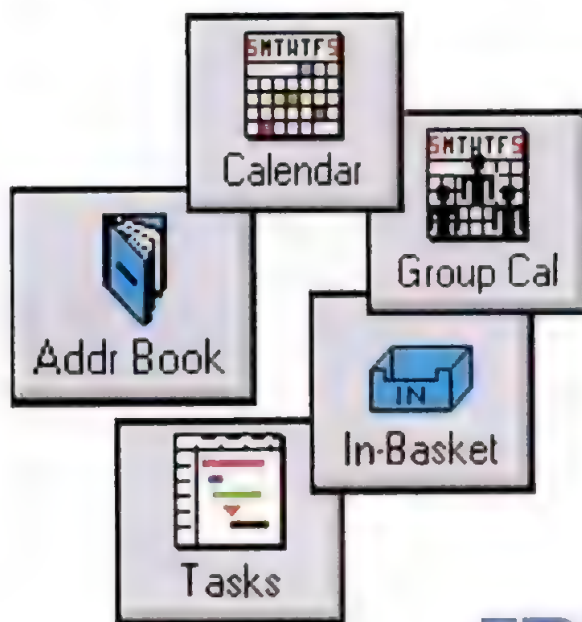
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Portable Printers

paper the company sent us with the unit—the printed output is sharper and crisper than that of comparable ink jet units, although text, curves, and diagonals are slightly more jagged because of the lack of *dot gain* (the amount that the ink spreads when it hits the page). Changing the print density yielded additional detail in dark areas that had a fair amount of detail.

Mannesmann Tally also recommends Weyerhaeuser First Choice and Hammermill LaserPrint White papers, which can cost \$5.50 to \$7 per 500 sheets, as opposed to the less expensive paper

On high-quality coated paper, the printed output produced by the MobileWriters is sharp and crisp.

(about \$3.50 per 500 sheets) such as Hammermill Savings DP copy paper, a brand commonly used by a large number of offices. On the lower-quality paper, the output was adequate for draft printing, although the printer couldn't attain solid blacks because of the paper texture. Using the higher-priced paper adds only about a half a penny per page, which is a relatively trivial amount compared with the ribbon cost of about 10 cents per page.

While replacing the thermal carbon ribbons (which come scrolled on two rods that slip into a carrier in the unit) is not difficult, it's one of those awkward processes that make you wish you had three hands. The printer is otherwise easy to set up and use. You open the rear of the unit to access the DIP switches. In addition, one of the ribbons we tested flaked off in spots onto the first few sheets of paper we ran through the printer. While you can feed transparencies through the printers, you can't feed envelopes. And if you're thinking that either one of these printers might be your portable solution for printing complex documents, think again: With a maximum of 1MB of memory for the MobileWriter and 2MB for

FACT FILE

MobileWriter

List price: \$875 (includes AC adapter/charger, ribbon, 80-sheet single-bin cut-sheet feeder, nonremovable nickel cadmium battery); 220/240-volt charger, \$38; cigarette-lighter adapter, \$75; five-pack of ribbons, \$75; carrying case, \$50

Requires: Parallel port.

Dimensions (HWD): 2.3 x 11.3 x 8.5 inches, 9.5 x 11.3 x 8.5 inches with cut-sheet feeder extended

Weight: 8.5 pounds, 10.8 pounds with AC adapter.

Emulations: HP PCL 4, IBM Proprinter, Epson LQ.

MobileWriterPS

List price: \$999 (includes AC adapter/charger, ribbon, 80-sheet single-bin cut-sheet feeder, nonremovable nickel cadmium battery); AppleTalk cable, \$18; 220/240-volt charger, \$38; cigarette lighter adapter, \$75; five-pack of ribbons, \$75; carrying case, \$50

Requires: Parallel port.

Dimensions (HWD): 2.3 x 11.3 x 8.5 inches, 9.5 x 11.3 x 8.5 inches with sheet feeder extended

Weight: 8.5 pounds, 10.8 pounds with AC adapter.

Emulations: HP PCL 4, PostScript

In short: The \$875 MobileWriter and the \$999 MobileWriterPS are both expensive and heavy (at 8.5 pounds each), though each does include a sturdy sheet feeder. If you need the features offered by these thermal-carbon-transfer units—PostScript, HP PCL 4, and speed—then you will find both printers more than satisfactory. Otherwise, you will not find any bargains here.

Mannesmann Tally Corp., 8301 S. 180th St.,
P.O. Box 97018, Kent, WA 98064-9718; 800-
843-1347, 206-251-5524; fax, 206-251-5520

 ON READER SERVICE CARD

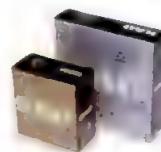
the MobileWriterPS, it's easy to hit the memory ceiling with downloadable fonts and graphics.

The MobileWriter and the MobileWriterPS both command fairly hefty weights and prices, though each does include a sturdy sheet feeder. The MobileWriter sells for around \$799 on the street (if you can find it); at press time, the MobileWriterPS was too new to have an established street price. If you need what they offer—PostScript, PCL 4, or speed—then you'll find both printers more than satisfactory. If your needs are less demanding and your budget more constrained, however, then you'll find no bargains here. □

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WIRELESS COMMUNICATIONS

Connecting Over The Airwaves

Wide-area wireless connections free you from the office—but make sure you're still in touch.



by Angela Gunn

IN THIS STORY

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Wouldn't it be nice to leave behind the physical constraints of your office—your desktop PC, your e-mail, your telephone—but never really lose touch? It's an immensely attractive idea to a lot of people, and wireless wide-area connectivity promises to deliver you into this new era. Some opportunities are available now, and in the near future the only questions you'll face as a user are how far you'd like to go and what kind of touch you'd like to keep. You'll even be contributing to the shaping of this market as you make your choices.

If you're an IS manager or network administrator, though, you'll face a few more questions—some tough, most without clear-cut answers right at the moment. But know that, for your trouble, you

will be able to offer your users a revolutionary new way of working. This is particularly so for two-way wireless. Although two-way technology certainly lags behind one-way in delivery, it holds greater promise for communications capabilities, flexibility, and reach.

With its markedly greater range than wireless local-area service (wireless LANs), wireless wide-area service (packet-radio, cellular, satellite) will untether you from the confines of your four walls and phone jack. Not just a clever ploy to keep you chained to the duties of your job, this technology has the potential to transform the way we use and produce data—just as Windows and the graphical revolution changed the way we present it. The change is real, it's for keeps, and it's rapidly advancing on all areas of business.

Among the concerns that should influence your selection of a one-way or two-way wireless service are signal penetration (are there lots of tall buildings around?), service access (which may be scarce in remote areas—heavily populated areas can mean delays), data rate (wireless probably will never match wire-bound, but speeds vary), interconnectivity (fortunately this issue is now raised early in emerging technologies), transparency to users (particularly for reaching those who travel widely), store-and-forward capabilities (for those who will occasionally be out of range entirely), power supply (another huge nudge for battery life to improve), and, always an issue, service costs.

Pricing is dicey in any new class of product or service, and especially so here, with many of the players only now jockeying for market position. A comparable cost structure will take some time to shake out, but we've hit the high notes on it and listed other considerations on the following pages. We've also noted some of the major service and hardware players and where they fit in the current flurry surrounding one- and two-way wireless technology.

Our Contributors: FRANK J. DERFLER, JR., is senior networking editor of *PC Magazine*. DAVID GREENFIELD is senior editor/networking of *PC Magazine*. ANDREW C. KANTOR is a staff editor of *PC Magazine*. ADAM A. HICKS is an editorial researcher at *PC Magazine*. ANGELA GUNN is a free-lance writer and former staff editor of *PC Magazine*. GAIL SHAFFER was the associate editor in charge of this story.

HIGHLIGHTS

Wireless Connections

THREE TYPES of wireless communications are worth your consideration for business solutions: one-way radio, two-way radio, and two-way cellular communications. At press time, only the radio systems are ready for the marketplace.

ONE-WAY communicators, which are descended from pagers, allow users to receive data only from special e-mail links or from subscription news services such as Individual Inc. or USA Today. The messages are downloaded to laptop or palmtop computers. EMBARC is the most important market player.

TWO-WAY RADIO transceivers can be attached to laptop or palmtop computers or contained in standalone units; they are appropriate for Internet or LAN-based e-mail transmission or for file transfers from the field. Two early entrants, Ardis and RAM Mobile Data, are in hot competition for dominant market presence in this field. RAM currently has a larger installed base, but Ardis offers users the ability to transfer larger messages and files.

Here's what you have to look forward to. With the right equipment, you will soon be able stay in touch with anyone, anywhere—and exchange messages containing much more than your phone number. You'll be able to update your files from miles away, and you can opt to receive your news not from an on-line service or your radio but from personalized news feeds sent directly to your pocket computer. And your voice mail will be able to reach out and touch you whenever you're away, or only under the circumstances you choose.

TWO-WAY CELLULAR service, CDPD (Cellular Digital Packet Data), is currently under development by a joint venture of IBM, eight of the nine Baby Bells, and several wireless service providers. Although it is not scheduled to be in place until later this year, this cellular network is expected to give Ardis and RAM some formidable competition.

MOTOROLA is the ubiquitous player in the wireless marketplace. Motorola played a part in developing both EMBARC and Ardis, as it did in much of the hardware that is designed to receive messages from those services. IBM also played a major role in Ardis, and Big Blue is much involved in the development of the coming cellular network.

MOBILE DEVICES for these networks range from pagers to palmtop- or notebook-based devices to dedicated units such as the InfoTAC. In the months to come, PDAs (personal digital assistants) from Apple, GO, and other manufacturers will vastly increase the demand for wireless connectivity.

It appears, as well, that you can look forward to a relatively smooth journey into this brave new world. The computer industry actually has been preparing for this shift for quite some time, and in many cases industry forces have been working together. Your first wireless communicator might not be a full-fledged personal digital assistant (PDA), but you probably won't need to worry about matching the data service with your hardware. Many manufacturers are working to cover all bases by including capabilities for as many kinds of service as they can.

Meanwhile, the service vendors are contending not only with each other but with the federal government as they struggle to establish transmission rights in the choicest parts of the electromagnetic spectrum (for more information,

Wireless Communications

see the sidebar "Bandwidth: What's the Fuss?" and the diagram "The Electromagnetic Spectrum"). So, you can relax and enjoy the fireworks for now, but in the meantime consider what type of service best meets your needs, anticipates your desires, and will fit into your system both today and tomorrow.

You have some time to spare, as the contenders are only now entering the ring and you're already familiar with many of the hardware archetypes. One-way communicators such as beepers and pagers are ubiquitous in modern society. And large portions of the mobile work force, such as police officers and delivery personnel, use two-way devices to transmit voice or data on a regular basis. In the next few years—as services increase their coverage areas, transmission speed, reliability, and volume capability—these devices will work their way into the hands of users who never realized they couldn't live without them.

ONE WAY HOME

Most people are familiar with the traditional hardware of one-way communications—beepers and pagers—that accept packet-radio messages sent through radio towers or even by satellite from a telephone link. Today's beepers accept alphanumeric data—mostly phone numbers or personal codes—and some brief messages. These are one-way in that the recipient cannot use the unit to respond to the message received (see the diagram

"Packet-Radio Communications").

The current national leader in one-way messaging is SkyTel, which operates both nationwide and regional alphanumeric messaging systems, including SkyPager, SkyTalk, and SkyWord. SkyPager allows senders to transmit a 12-digit number; SkyTalk stores voice-mail messages and beeps the recipient, who can then dial in to retrieve them; SkyWord delivers alphanumeric messaging through any X.400 e-mail gateway or through such services as MCI Mail and AT&T EasyLink.

In the SkyTel systems, messages are transmitted by phone lines to one of two redundant switches that packetize the data and send it on further to a satellite uplink. From there the message is simultaneously broadcast to 90 percent of the continental United States. Coverage in Canada, Mexico, Asia, and other areas is also available. The sender need not know the location of the recipient. Users who remove their receivers from the network (whether because they move out of range of a transmitter or because the beeper is shut off) can retrieve their messages over the telephone.

SkyTel transmits data at 930 to 931 MHz, a portion of the electromagnetic

spectrum near the spread-spectrum radio band used by many wireless LANs. This part of the spectrum is dedicated to messaging services such as theirs. It's also used by EMBARC, a service company that hopes to supplant SkyTel as the leading national one-way messaging service.

With its service, EMBARC (Electronic Mail Broadcasts to A Roaming Computer) addresses one of the few drawbacks of the current SkyTel system: limited message size. EMBARC integrates the immediacy and reliability of paging with the data-storage capabilities of portable computers. Even SkyTel's SkyWord system cannot handle messages that contain more than 240 characters. EMBARC, on the other hand, allows users to send messages containing up to 30,000 characters. In addition, these messages can be linked together to form longer messages. EMBARC also allows senders to broadcast their messages simultaneously to a number of receivers, a feature that is useful for updating the same file on several remote machines.

One of the newer uses for one-way messaging is the reception of news services. EMBARC, for example, has aggressively courted a number of news and

*These devices will
work their way into
the hands of users
who never realized
they couldn't live
without them.*

▪ Bandwidth: What's the Fuss?

by Angela Gunn

Whether a wire is made of copper or glass, transmitted signals share the space only with other data.

Wireless transmissions, on the other hand, share space with light, radio, and radar, among other things. *How* the data moves and the physical points it can reach are determined by the service supplier. The way the data *shares* its invisible wire with other transmissions is dictated by the Federal Communications Commission (FCC), which allocates rights to the electromagnetic spectrum.

The lower bandwidth (see the diagram; also see "The Electromagnetic Spectrum: Where Wireless Fits In," in *PC Magazine*, February 11, 1992, page 308) carries audible sounds; upper reaches carry light and subatomic particles. Hence the bandwidth currently usable for inexpensive, reliable land transmissions is inherently limited.

Most of that bandwidth is already assigned to local governments and to the petroleum and maritime industries. Other parts of the spectrum are open but are relatively crowded; for example, spread-spectrum radio (902 to 928

MHz) is also used by indoor security and paging systems.

The FCC plans to clear the 2-GHz space for wireless communications, but earlier settlers object to relocation because of the trouble and expense. Thus industrial users of the spectrum are suddenly holding valuable pieces of electromagnetic real estate.

The battle for transmission bandwidth will be fought in the courts and legislatures. Several segments, notably 930 to 931 MHz and 2 to 2.4 GHz, are promised to companies willing to pioneer services at those frequencies. □

information agencies. It currently works with several excellent providers, like Gannett, which offers a digest of information from USA Today. For a monthly fee, users can subscribe to news feeds that carry financial reports, news updates, sports scores, and special-interest topics. The main news feed is transmitted early in the morning, with breaking news sent throughout the day. Users can choose the news feeds to which they wish to subscribe, just as you might pull apart the morning paper and read only the sections in which you're interested. Other news services, such as Individual Inc., go even further, providing personalized clipping services.

THE MORE CONNECTIONS, THE BETTER

Of course, hooking in to public information providers is something most users will do in addition to the connection they make with their LANs—also through EMBARC or SkyTel. With access to one of the supported mail services or to a gateway, a LAN administrator could set up a service that automatically updates data on any number of remote machines. An X.400 gateway can also forward e-mail or even voice mail.

To accomplish all this, both services use essentially the same hardware: a palm-sized receiver that attaches to a laptop, notebook, or palmtop. The first one-way messaging device to transcend the beeper was Motorola's NewStream (marketed by SkyTel as the SkyStream), which snaps to the side of the Hewlett-Packard HP 95LX and HP 100LX Palmtop PCs. (By the time you read this story, Motorola plans to have introduced the NewsCard, a PCMCIA card with a battery and receiver that can attach to a number of notebook or laptop computers. Expect SkyTel to roll out the same unit under its own name.)

On the service end, EMBARC currently holds the best technology cards. Designed to handle larger amounts of data, EMBARC transmits an 8-bit binary signal, whereas SkyTel uses the older 7-bit signal. SkyTel, however, has the ad-

FEATURES PLUS

Join us August 2 through August 6 in ZiffNet's Executives On-line Forum to discuss wireless communications with Frank J. Derfler, Jr., *PC Magazine's* senior networking editor, and guests from several of the companies featured here. Type GO ZNT:EXEC from any CompuServe prompt.

vantage of flexibility, since users need not subscribe to a single system the way EMBARC users do. Expect SkyTel to surge back to the marketplace with services of its own: Already evaluating potential information providers, SkyTel has pledged to support a number of handheld communicators and to increase message length.

IT TAKES TWO

All of that is fairly exciting for wide-area connections of the one-way variety. But most users, brought up with visions of Dick Tracy's two-way wrist radio, have higher expectations. The real battleground for the hearts and minds of wireless users lies in two-way communications, which let you both receive and send messages solely through your wireless device.

Two-way communications offer true e-mail capability; they also let wireless users communicate both with wired sites and with each other. Until now, the model for two-way communications has been the phone system. Indeed, wireless two-way data communications is largely untried, and no one has yet determined the features that should be included in such a system. Two methods of transmission, packet-radio and cellular, are intended to fill the gap. The two share great similarities; it is their differences, however (and although dictated by the transmission type) that reveal contradictions in their basic philosophies.

RADIO DAYS

Two-way packet-radio communicators work much like their one-way cousins. Data is sent from a source and passed through a series of switches; there the signal is broken into packets to which addressing information is added. Next the packetized signal is sent to a satellite link and broadcast to base stations, from which it seeks the addressee. Because the link is two-way, error correction can be used, and the network as a whole uses collision detection to regulate traffic flow, much like the Ethernet LAN architecture does. In fact, Ethernet's collision-detection

scheme was originally developed as a packet-radio technology.

At the present time, Ardis, RAM Mobile Data (Mobitex), and Nextel Communications (which changed its name from Fleet Call in April 1993) are emerging as the preeminent packet-radio services. Ardis, a joint effort from IBM and the ubiquitous Motorola, was originally developed for communication between IBM's cadre of field engineers and their home mainframes; at first, it existed mainly for vertical applications. RAM was originally developed by Bell South and RAM Mobile Data (GE Ericsson is also currently a partner) specifically as a broad-interest, wide-usage wireless network. And Nextel started life as a service provider for truck fleets and other mobile enterprises.

CELL BLOCKS

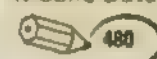
Cellular communicators, on the other hand, operate much like cellular phones and even use the same portion of the spectrum. However, like radio, the cellular signal is digitized. From a wirebound system, the signal is carried to the phone

FACT FILL

Ardis

Ardis, 300 Knightsbridge Pkwy.,
Lincolnshire, IL 60069; 800-662-5328,
708-913-1215; fax, 708-913-4700

A joint venture between IBM and Motorola, Ardis is a two-way radio service with 1,250 base stations that reach about 80 percent of the U.S. population. Ardis has its roots in the true blue vertical installations of the early 1980s, but now it is slowly branching into the consumer marketplace. The service boasts a speed of 19.2 kilobits per second—faster than RAM Mobile Data, its most important competitor. Ardis was originally designed for use where radio transmission was difficult; its MDC 4800 protocol (which was proprietary until May 1992) ensures that your transmission is clear. However, it does not yet have RAM Mobile Data's ability to store and forward messages when a user is out of range. In addition, although the current price of Ardis field terminals is much higher—at \$1,500 to \$5,000—than that of RAM Mobile Data units, indications are that you can expect to see a multitude of equipment that is being designed to handle both Ardis and RAM Mobile Data transmissions.



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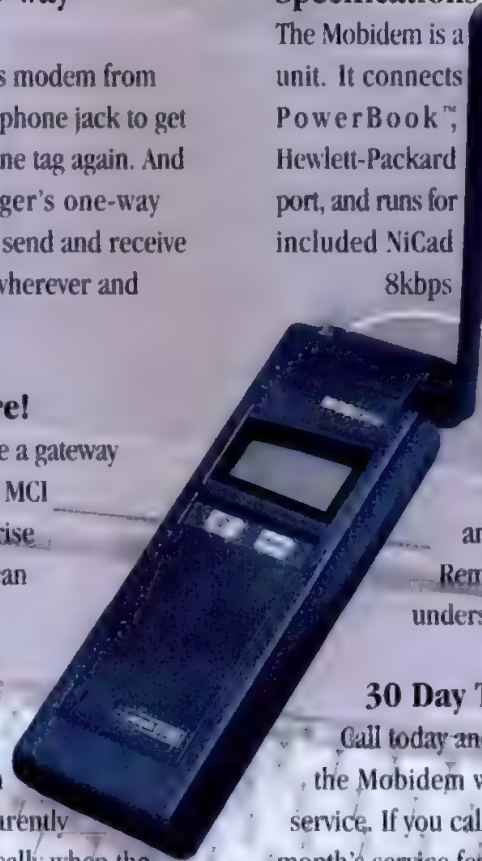
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RadioMail

company and onto a cellular site, where it is reformatted (see the diagram "Cellular Communications").

At the site, the network monitors the airwaves, listening for the end of a voice call. All cellular calls are required to have a 5- to 10-second quiet period after disconnection while the line resets itself, so the data network uses that time to broad-

cast its packets, which then travel to a base station and on to the receiver. The process is reversed if the signal is sent from a mobile unit.

CDPD (for Cellular Digital Packet Data), although not yet available at press time, is nevertheless expected to be an important cellular service. It will be the product of a massive consortium that in-

cludes IBM, McCaw Cellular Data, eight of the nine Baby Bells (the ninth, Bell South, is a partner in RAM), and various other companies.

PUTTING IT ALL TOGETHER

How do these devices fit into your current office setup? Devices that support the various services are pouring into the

■ The Free-Floating Office

by Angela Gunn

While the industry readies itself for the PDA (personal digital assistant) revolution, wireless LANs continue to make steady market progress. Spread-spectrum and narrowband radio as well as infrared systems are all represented in the current market offerings. The last time we looked at wireless LANs ("Portable, Affordable, Secure: Wireless LANs," *PC Magazine*, February 11, 1992), just three products—from BICC Communications, Motorola, and NCR Corp.—were ready for evaluation. Eighteen months later, the half-dozen vendors listed below provide a comprehensive view of the market.

BICC NO, INFRALAN TECH

BICC Communications is out of the wireless business, having sold its InfraLAN infrared products for Token-Ring networks to InfraLAN Technologies (Cambridge, MA; 508-266-1500). The latest incarnation of InfraLAN can support both 4-Mbps and 16-Mbps Token-Ring networks and has a range of 80 feet. Each InfraLAN unit sells for \$3,795 and can support up to six workstations. A 4-Mbps version is \$2,795.

MOTOROLA

Altair, from Altair Product Operations, a division of the Motorola Paging and Wireless Data Group (Arlington Heights, IL; 800-233-0877, 708-538-4800) evolved into the Altair Plus II. The Ethernet-based network has an SNMP-compliant management agent as well as radio-specific MIBs (message information blocks); scalable through-

put now reaches 5.7 Mbps. The system still uses the narrowband 18-GHz frequencies, and its architecture is the same: User Modules can be wired to as many as eight nodes; these move data to the Control Modules located directly on the Ethernet network. Control Modules sell for \$4,995. User Modules cost \$1,195 with 10BaseT ports and \$1,295 with 10Base2 or 10Base5 ports. They carry a three-year warranty.

NCR (AT&T'S FRIEND)

NCR (Dayton, OH; 513-445-5000), with technological assistance from AT&T, continues to expand WaveLAN, its spread-spectrum system. The latest additions allow wireless users to tie into multiple wired LAN segments more easily. Adapters for individual nodes sell for \$695; a PCMCIA model will retail for \$695. WaveLAN users may be interested in the AirLAN Internal and the AirLAN Parallel wireless LAN adapters that work with the NCR system. These sell for \$799 and \$699, respectively, from Solectek Corp. (San Diego, CA; 619-450-1220).

PROXIM

Proxim Inc. (Mountain View, CA; 415-960-1630) has entered the market since we last visited this product area in 1992. Proxim offers RangeLAN, a spread-spectrum LAN package with middling speed. Proxim's RangeLAN/Parallel adapters are external units, plugging into the parallel port. The company also offers a PCMCIA adapter. Both products have an indoor range of 300 to 500 feet, a data rate of 242 Kbps,

and sell for \$595. LAN adapter cards are available for \$495.

TELXON TAKES TELESYSTEMS

Telesystems (Don Mills, Ontario) is now a subsidiary of Telxon (Akron, OH; 800-800-8006), but its Arlan 600 series line of wireless hubs, bridges, and adapter cards is still on the market. The LAN is Ethernet-based and uses spread-spectrum radio to transmit at up to 1.35 Mbps. It has a range of up to 1,200 feet indoors. Directional antennas for line-of-sight interbuilding use can be connected up to six miles away. The latest addition to the product line is the Arlan 680 Wireless Network Adapter (\$995), which plugs into the parallel port of pen or notebook computers and communicates with the 610 Wireless Ethernet Hub (\$2,490). Half-size adapter cards sell for \$895 (ISA) and \$995 (MCA). Products operating at 2.4 GHz are also available.

WINDATA

At our last review, Windata (Northborough, MA; 508-393-3330) was not yet marketing the FreePort, its spread-spectrum LAN. An Ethernet LAN with an SNMP-compliant network management platform, it is now shipping in volume. By far the fastest spread-spectrum package on the market, it offers throughput of 5.7 Mbps, an aggregate data rate of 12 Mbps, and a range of 260 feet. The FreePort hub, which supports 62 transceivers, sells for \$7,450; transceivers with all the interface devices necessary for an unlimited number of nodes cost \$1,775. □

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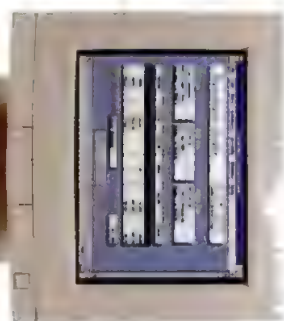
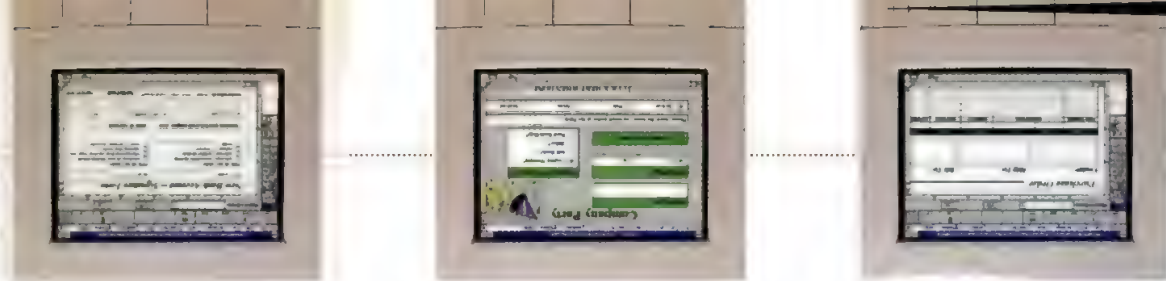
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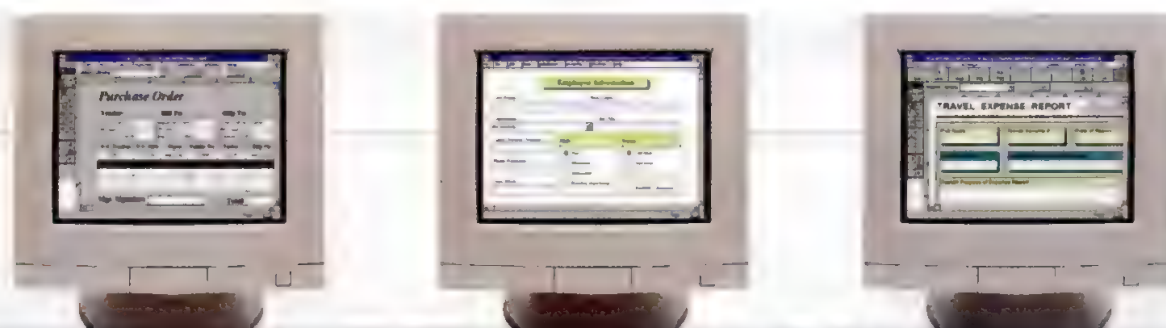
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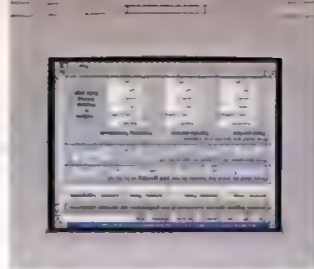
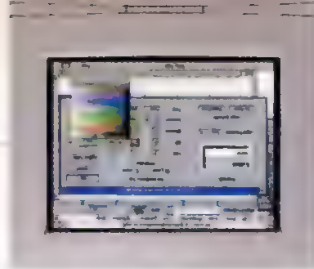
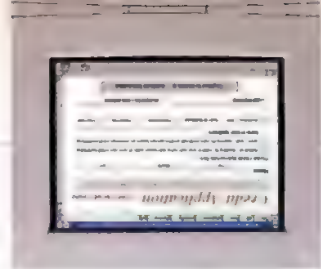
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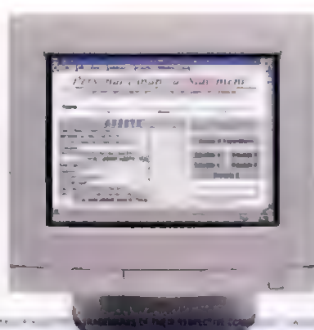
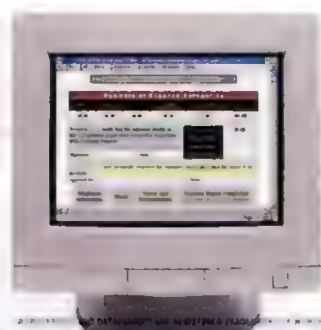
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WordPerfect

Wireless Communications

marketplace. Vendors of e-mail and other communications services are lining up to add support to their systems. And the services themselves are working with applications developers to ensure that support for the products is complete and robust.

Motorola, which has long held the lion's share of the pager market, supplies many of the devices now used to communicate with the various services. For one-way communications, it offers NewStream and NewsCard, both of which are remarketed by SkyTel. InfoTAC, a two-way standalone radio system, supports Ardis and some other public networks; indications are that it will eventually support RAM as well. IBM's PCRadio, which started as an Ardis-only transceiver, now supports both Ardis and RAM (via a Mobidem modem). And Motorola has already announced that the future devices it markets will support Ardis and a number of

wireless LANs, thus bringing the roaming computer safely back to the office (for more on wireless LANs, see the sidebar "The Free-Floating Office"). Most of the PDAs heading toward the market in the future will commit to supporting several wireless services.

Most of the PDAs heading toward the market in the future will commit to supporting several wireless services.

CHOICES, CHOICES

Several considerations should enter into your deliberations in the selection of a two-way wireless service. All of the technical considerations, of course, should be weighed against the individual objectives, business or otherwise, when choosing wireless capabilities for yourself or someone else in your organization. The potential here for mobility is tremendous, and that potential could substantially diminish another factor that usually would take precedence—even something like cost, which remains central to most purchase decisions.

Signal penetration and access. If you

FACT FILE

CDPD (Cellular Digital Packet Data)

McCaw Cellular Data, Wireless Data Div.,
5400 Carillon Point, Kirkland, WA 98033;
206-827-4500; fax, 206-828-2380

A consortium of IBM, AT&T (via McCaw Cellular Data), GTE Corp., and an assortment of Baby Bells and other telephone companies, CDPD (for Cellular Digital Packet Data) is expected to be the next big thing in wireless wide-area communications. CDPD is powered by the IBM technique known as Celluplan II, which allows data transmissions to channel-hop among the ever-changing openings in the midst of cellular voice traffic. The service, which should have entered some vertical markets by the time you read this, has great advantages in potential coverage and in support for voice and data calls. However, its reliance on the availability of bandwidth in the already crowded cellular frequencies may frighten off early users.

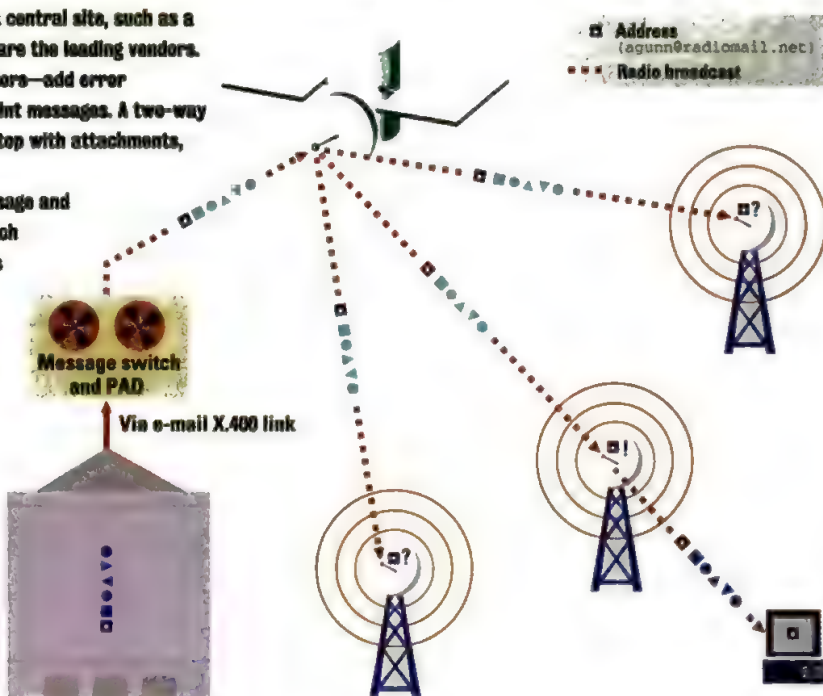
 ON READER SERVICE CARD

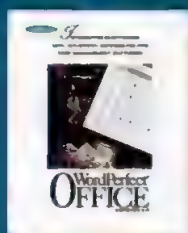
live in a metropolitan area, you must be already familiar with the problems of receiving radio signals without interference. If you live in a rural community, you may have a limited number of radio

Packet-Radio Communications

One-way messaging is used for transmitting data from a central site, such as a news service, to many remote units. ENBARC and SkyTel are the leading vendors. Two-way systems—Ardis and RAM are the main competitors—add error correction, which is essential for e-mail and point-to-point messages. A two-way transceiver may be a dedicated unit or a palmtop or laptop with attachments, supporting Ardis, RAM, or both.

In either case, the originating service creates the message and transmits it via an X.400 link to the message switch, which packetizes the signal for transmission. The switch moves the message to an uplink packet assembler/disassembler (PAD). The PAD transmits the uncoded signal up to the satellite link, which then sends the message to base stations. These stations broadcast the message across North America. Each site examines the addresses of the receivers in its coverage area; the site hosting the receiver with the proper address forwards the message to the unit. If the unit is not located in any coverage area, the message is held at the transmitting site for a period of time or until the unit reappears. Messages can then be retrieved via land line. The process is reversed for transceiver signals moving in the opposite direction.





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VESA Local Bus Slots	3	None
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Wireless Devices Go Mainstream

by Adam A. Hicks

Here's a sampling of companies that already market pagers and communicators to connect you to wireless services.

MASS MARKET ONE-WAY PAGERS

► FACT FILE

Piepser

Swatch, New York, NY; 800-879-2824

List Price: \$99

Circle 483 on reader service card

► FACT FILE

Bravo Express

Motorola Inc., Boynton Beach, FL; 800-551-6675

List Price: \$199.95

Circle 482 on reader service card

BUSINESS ONE-WAY PAGERS

► FACT FILE

Advisor

Motorola Inc., Boynton Beach, FL; 800-551-6675

List Price: \$349.00

Circle 484 on reader service card

► FACT FILE

NewsStream

Motorola Inc., Boynton Beach, FL; 800-362-2724

List Price: For the Mac or PC, \$395; for the HP 95LX or 100LX, \$458

Circle 485 on reader service card

TWO-WAY COMMUNICATIONS

► FACT FILE

InfoTAC

Motorola Inc., British Columbia, Canada; 800-247-2346

List Price: \$1,350

Circle 486 on reader service card

► FACT FILE

Mobidem

Ericsson GE Mobile Communications Inc., Paramus, NJ; 800-223-6336

List Price: Viking Express: HP 95LX with 512K RAM and Mobidem modem, \$995

Circle 487 on reader service card

PERSONAL DIGITAL ASSISTANTS

► FACT FILE

EO Personal Communicator

EO Inc., Mountain View, CA; 800-458-0880, 415-903-8100

List Price: EO Personal Communicator 440, starts at \$1,999; EO Personal Communicator 880, starts at \$2,999

Circle 488 on reader service card



Swatch Piepser, Motorola Bravo Express



Motorola Advisor, Motorola NewsStream



Motorola InfoTAC, Ericsson Mobidem modem

BUY THE WRONG RISK LOSING MORE

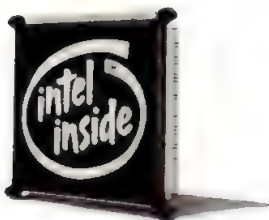
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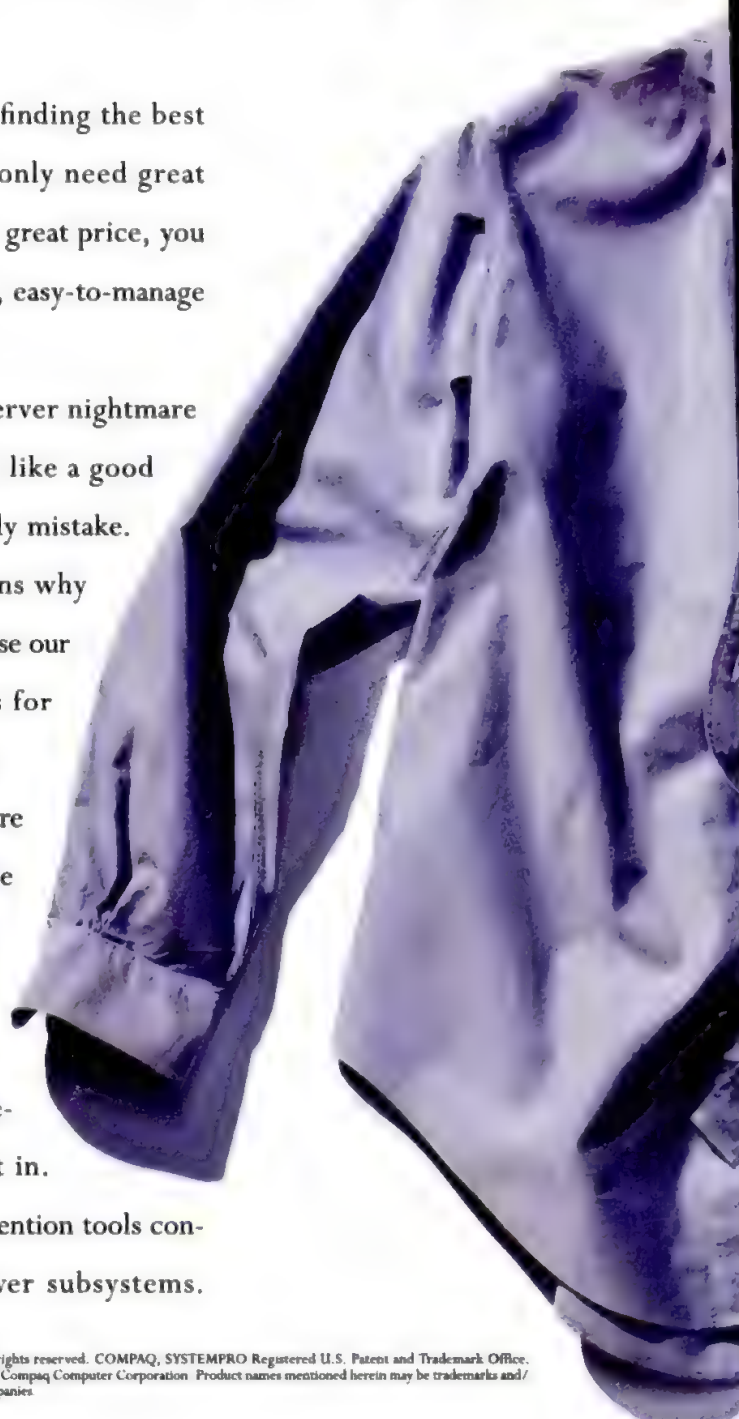
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Wireless Communications

FACT FILE

EMBARC

EMBARC Communication Services,
1500 NW 22nd Ave., Boynton Beach, FL
33426-8292; 800-362-2724

EMBARC (Electronic Mail Broadcast to A Roaming Computer), currently the preeminent one-way messaging service, uses radio broadcast methods to send information from a central provider to one or many receivers. It uses a one-way data channel at 930 to 931 MHz, licensed to Motorola. Descended in part from Motorola's market-dominant paging technology, EMBARC lets you send messages of any length by linking blocks of up to 30,000 characters each. Messages can be sent from any e-mail system attached to an X.400 gateway and can be received by laptops or palmtops equipped with special receivers such as NewStream, SkyStream, or the upcoming PCMCIA-based NewsCard. A number of news and financial services, including GE Information Services, Individual Inc., and USA Today are also available by subscription.



stations from which to choose. The same holds true for wireless communications.

In metropolitan areas, building penetration is about the same for RAM as it is expected to be for CDPD. In other

words, if you're in a large building surrounded by skyscrapers, you're not likely to get a clear signal. Ardis, on the other hand, was developed in part specifically to work inside buildings; hence its signal penetration is excellent.

In less densely populated areas, the odds of finding a usable service generally range from slim to none. Ardis presently reaches about 95 percent of the business population (that is, about 80 percent of the general population); RAM reaches about 90 percent. The most recently formed service, CDPD, is expected to reach about 50 percent of the overall wireless market by the end of this year. Further expansion will take time as the initial investment is recouped and may progress as economic necessity dictates.

Service access. Cellular-phone users in cities such as Los Angeles and New York are familiar with the difficulty of "getting a line" at certain times of day. Because CDPD will use the same circuits, you

could have trouble getting space for your data transmission. Ardis, Nextel, and RAM all use dedicated services, so the problem is diminished.

Data rate. Data rates for wireless services are hardly impressive to anyone who's shopped for a modem in the past few years. Moreover, wireless data networks are designed under the assumption that connections are unstable. The resulting error correction procedures required to ensure clean transmission slow down system speed considerably. Ardis (and potentially CDPD) will clock in with top speeds of 19.2 Kbps, RAM at about 8 Kbps (some overhead is involved). Users will notice an annoying 6- to 12-second pause between action and reaction when using any of these systems.

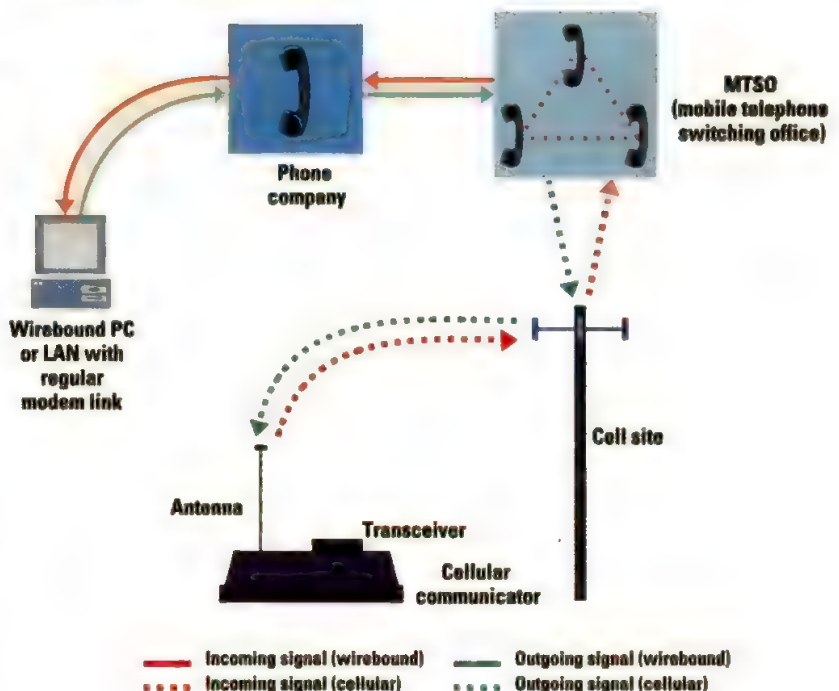
In practical terms, it won't be possible to send large files on any of these services for the near future; instead, they will be used primarily for electronic mail and for simple queries to a database. But if your

In less densely populated areas, the odds of finding a useable service range from slim to none.

Cellular Communications

Cellular data transmission is much like cellular voice transmission. In fact, they share the same bandwidth. The genius of CDPD (Cellular Digital Packet Data), one of the most important forces in the nascent cellular market, is its technique of interspersing the data amid the volume of voice traffic already on the air. No new voice call may pass over a cellular link until 5 to 10 seconds after the previous call has disconnected. The CDPD plan would use that "guard band" to move data.

Cellular calls actually stay wirebound for a considerable portion of their journey. If the signal originates at a wirebound system, it passes to the phone company's switch by wire. From the switch, the signal moves to the MTSO (mobile telephone switching office), where it is converted to the cellular frequency and format and moved to a cell site for broadcast. If the message originates at the cellular end, the path is reversed. When two cellular units are within range of the same cell site, the call moves through the cell site to the MTSO, then back again.





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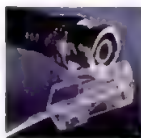
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CIRCLE 106 ON READER SERVICE CARD

Wireless Communications

needs require you to move considerable amounts of data, you'll need to take these throughput numbers into consideration.

Interconnectivity. The proliferation of data services, none of which have yet established dominance, will worry anyone concerned with hardware obsolescence. Fortunately, many of the hardware vendors have smoothed the path, and many machines offer connectivity to at least two of the available systems. You're most likely to find devices that offer both Ardis and RAM compatibility, but CDPD support is in the works for many units. IBM envisions devices that can operate as a wireline modem, a switched-cellular modem, a CDPD subscriber unit, and a cellular telephone.

Transparency. It shouldn't be a chore to contact anyone carrying a wireless communicator. Both RAM and SkyTel feature transparent roaming, which puts the burden of location on the service itself. Ardis, on the other hand, requires that users register with the cell with which they want to communicate (although Ardis plans to announce roaming support later this year). CDPD developers plan for it to feature transparent roaming. Although some protocols have been written and implemented to smooth the transi-

FACT FILE

Nextel

Nextel Communications Inc., 3675 Mount Diablo Blvd., #330, Lafayette CA 94549; 510-299-2000; fax, 510-283-9417

Nextel Communications Inc.—which changed its name from Fleet Call in April 1993 and is best known for its Specialized Mobile Radio (SMR) systems for mobile enterprises such as taxis and delivery fleets—is in the process of constructing its own Digital Mobile Network with the blessing of the FCC. Nextel plans to have the network up and running in Los Angeles this August, with the rest of California up by early 1994; Chicago and New York are targeted for mid-1994; Dallas and Houston, mid-1995.

SMR networks will carry data, voice, and dispatch service signals—thus delivering more options than either cellular or packet radio. However, the system offers no roaming capabilities, and it works best for users who need to stay in touch only within a set geographic area. The service's existing infrastructure, since its recent merger with Dispatch Communications, can reach up to 105 million people. Although it has been positioned primarily as a competitor to cellular phone systems, Nextel offers intriguing possibilities for bridging the radio-cellular gap.

ON READER SERVICE CARD

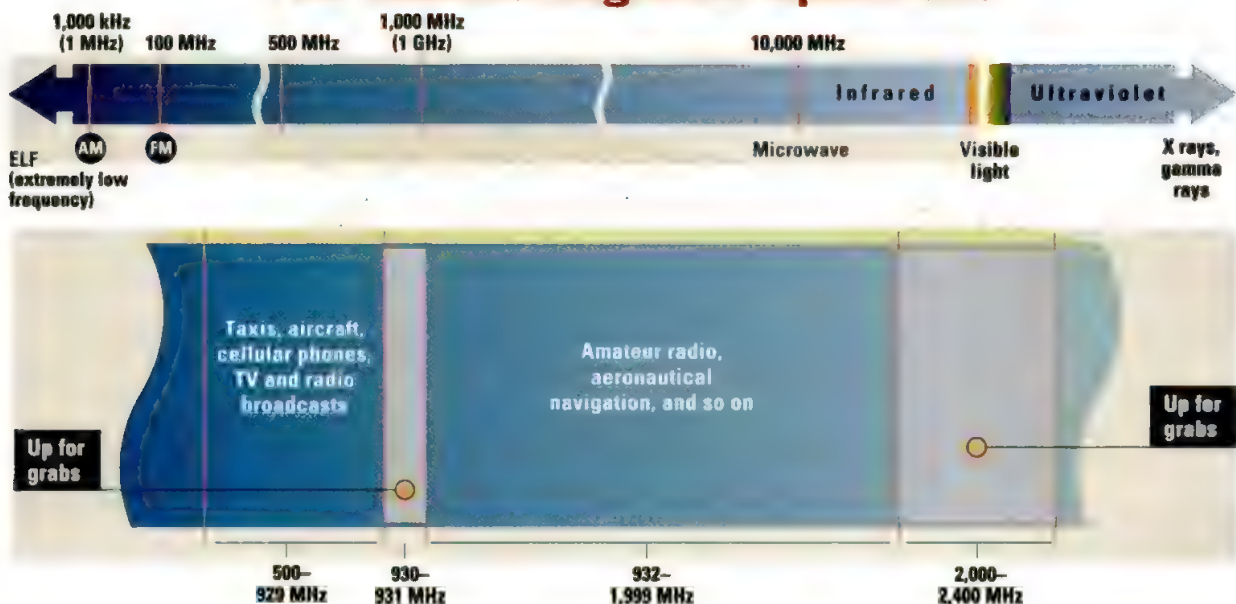
tion, more work must be done.

Store-and-forward. If you move out of signal range, or if you have to shut off your wireless unit (airlines, for example, absolutely forbid the use of any cellular or packet-radio device while the plane is taking off and in motion), it is essential that your messages wait for you somewhere for later retrieval. Because RAM Mobile Data uses transparent roaming, forwarding is not a problem: The service holds undelivered messages for 12 hours or until the unit beacons again. For CDPD, store-and-forward capability will be accomplished (or not) by individual service providers.

Power. As with anything else that depends on batteries, power consumption is a major concern for users of wireless communicators. GE Ericsson's Mobidem has a built-in sleep mode; in addition, the network is geared toward minimal power consumption, and life for the rechargeable battery is about 10 hours. Battery life for Ardis units is rated at about 2 hours. Frequent flyers should seek out units that use AA batteries: These batteries are usually the easiest to find in airports because they are the kind most commonly used for personal stereos.

Pricing. Value-added providers will

The Electromagnetic Spectrum



A limited amount of bandwidth is currently unassigned (here marked "up for grabs"). The FCC is charged with allotting bandwidth to various services, but the final allocations are likely to be decided in the courts and legislatures.

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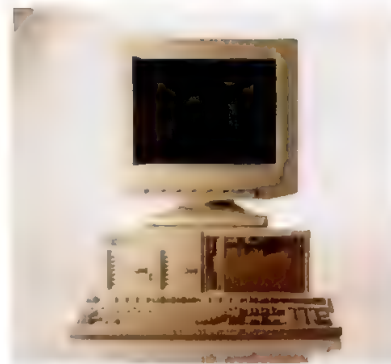
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Wireless Communications

charge as they will, but each service does have a basic pricing structure and rate. As a rule, pricing varies for both one-way and two-way communications. One-way services are generally more stable from month to month; two-way services vary somewhat not only in rate but in pricing structure and mechanism.

Like paging services, one-way data services usually charge a monthly subscription rate that includes a set number of message blocks. Additional charges include installation and any messages that run over the limit in the base subscription rate. And, as stated above, senders pay for only one transmission—no matter how many users it reaches.

SkyTel, for example, charges \$99 for installation and \$99 per month for its SkyWord alphanumeric system. SkyTel's

monthly rate allows 50 text messages of unspecified length; additional units of 50 words cost \$0.29 per unit. EMBARC charges \$395 for the NewsStream hardware and connection fee and \$18 per month, but message charges are determined by geography and priority. For example, the rate for a 100-character message sent nationwide with a priority time frame designated (within 15 minutes) is \$2, whereas the same message sent in a single region on standby (up to 24 hours) would cost only \$0.07. Note, however, that the basic subscription to EMBARC includes a subscription to the daily USA Today weather and news-brief service.

Early prices for the plethora of electronic news feeds seem to be relatively reasonable. USA Today offers groups of news specialty services in such areas as

finance, technology, and law; most subscriptions to individual feeds rarely go above \$12 per month.

Meanwhile, two-way services attempt to remain roughly equal in price to each other: RAM Mobile Data estimates that a 1K message should cost about \$0.25 to \$0.30, and the other services are planning to stay within that range. However, pricing is developed and set quite differently among the packet-radio and cellular services. Cellular transmissions, like cellular calls, are priced by duration, whereas packet-radio transmissions are priced by the amount of data being transferred (regardless of the amount of time that the transfer takes).

Hardware costs are a lesser consideration in evaluating these services. Moreover, much of the hardware is still enter-

Wireless WAN/LAN Approaches

By Angela Gunn

Whether you're planning to connect within a building or across the country, you'll need to consider a variety of criteria when choosing a wireless technology. With several wireless routes emerging, you have an opportunity to choose well. Being clear about your business or personal initiatives for establishing such connections is the first step.

If you need to be connected no matter where you go, you have three options. *Packet-radio* modems transfer data cheaply, although coverage currently is limited. But they have one advantage for now: They're here. *Cellular* data transmission is coming soon, though, and its voice support might lure forward-thinking buyers who aren't worried about transfer rate or cost.

And *mobile satellite* systems, which promise worldwide coverage (for a price), are still some time away.

If you're just trying to avoid laying cable within the office and don't need to take your e-mail on the road, three possibilities await you. *Infrared* LAN technology is an inexpensive and easy-to-use alternative to stringing wires, but like a television remote control, it's limited to line-of-sight use.

Microwave-based LANs avoid that limitation with signals that can penetrate a few walls but will not travel much further. *Spread-spectrum* radio is not bothered by walls, although electromagnetic fields do interfere and hardware costs may scare away the budget-conscious.

Service type	Usage	Network type	Benefits	Drawbacks	Representative suppliers
Cellular	Circuit-switched roaming modem and telephone connections	WAN	Mobility; mature technology; existing infrastructure; voice and data support	Expensive if connection is poor; not yet available; penetration may be poor	CDPD (service under development)
Infrared	Line-of-sight data transmission	LAN, peripheral-sharing devices	Ease of installation and use; mature technology; permits faster transmission than many other wireless LANs	Line-of-sight transmission only; units must be aligned and data path kept clear	BICC, Photonics, Windata
Microwave	Short-range data transmission	LAN	5.7-Mbps data rate; ease of installation; good compatibility	Signal cannot penetrate many walls; inappropriate for highly mobile sites	Motorola
Mobile satellite	Highly mobile messaging and location services	WAN	Saturation coverage; reliable connections	Expensive; mediocre data rates; limited capability	American Mobile Satellite Corp., Orbital Communications, Qualcomm
Packet radio	Packet-switched roaming data transmission	WAN, messaging services	Mobility; user pays only for packets transmitted	No current voice support; coverage limited to large metropolitan areas	Ardis, EMBARC, Mobile RAM Data
Spread-spectrum radio	Short-range data transmission	LAN	Signal capable of penetrating a number of supporting walls; flexibility	Unreliable near heavy electromagnetic transmissions; requires one transmitter per linked PC	NCR, O'Neill Communications, Proxim

results and reader feedback continue to suggest that DOS 6.0 DoubleSpace is causing significant problems on a wide variety of DOS machines.

— InfoWorld
May 10, 1993

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ing the market. The most common delivery mechanism, the one-way pager, runs about \$400 and is widely available. GE Ericsson's Viking Express package, which connects to the RAM Mobile Data network, includes an HP 95LX Palmtop PC with 512K RAM and a Mobidem modem; it costs \$995. And the InfoTAC, a dedicated unit that supports Ardis and some other public networks, goes for \$1,350.

PHILOSOPHICAL DIFFERENCES

Beyond these issues lies the question of what, exactly, do you want your wireless communicator to *do*. Both packet radio (one-way as well as two-way) and cellular have advantages that define what a personal communication device *could* be. But only the market can dictate what it *will* be; as users select which services they'll use, features will appear and disappear.

One-way communicators are geared toward broadcasting in the literal sense. The information goes out to anyone who is listening, and no feedback is expected.

And because the sender is billed for only one transmission regardless of the number of recipients, this service is ideal for one-to-many communications. Administering a one-way system can be as easy as installing and maintaining a data gateway—or as simple as subscribing to one of the electronic mail services.

Two-way packet radio devices have excellent reliability and acceptable speed. Their error correction and instantaneous communication make them ideal for e-mail, as does the billing process: You pay for the number of packets sent, not for the time

it takes to send them. Both two-way packet services are available now in a number of devices. Perhaps they're not the right service, but at least they offer service right now. Meanwhile, RAM's transparent roaming will endear it to travelers, while users who stay closer to home and need serious access to a wire-bound LAN will prefer Ardis for its remote access.

Cellular service, on the other hand, has one mighty advantage over the other services: voice. This plays strongly in favor of CDPD. None of the other services is capable of delivering a voice signal today. Packet-radio technology offers the potential, but the quality of the transmission has yet to be established.

Any of these services will succeed to the extent that it reliably handles all the kinds of transmission that users want to transmit, and provides transmission capability in enough areas.

BE CAREFUL WHAT YOU WISH FOR

All of this said, users will have to ask themselves honestly whether they want what wireless communications means. Some of the benefits and drawbacks to these services cannot be evaluated merely in terms of their features. With a paradigm shift in the technology comes a shift in user attitude toward it.

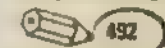
One consideration is safety. Concerns have been raised over the years about the danger of exposure to low-level electro-

FACT FILE

SkyTel

SkyTel Corp., 1350 I St. NW, Washington, DC 20005; 800-456-3333, 202-408-7444

SkyTel, a subsidiary of Mtel, delivered the first nationwide paging and voice messaging service in 1987, which today reaches about 90 percent of the country. Of all the services covered in this overview, SkyTel's is the most similar to the familiar beepers and pagers of previous years, and user-friendly features such as toll-free access numbers make the technology unthreatening and simple to use. In addition, this system supports a number of data connections, including synchronous, UUCP, and X.400 over dial-up, dedicated, or packet-switched lines. It has store-and-forward capabilities, and both 7- and 8-bit binary file transfers are possible. Currently SkyTel permits messages no larger than 240 characters, but a change here is imminent. The company holds an FCC Pioneer's Preference, which gives it rights to develop a 24-kilobit-per-second two-way messaging service in that area of the spectrum.



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magnetic fields. In the past, computer equipment had to meet strict guidelines set by the FCC for shielding users from electromagnetic radiation; these devices emit radiation directly as they work.

Ardis units transmit packets in burst mode at 3 watts; devices that support RAM use 2-watt packets for burst-mode transmission; and CelluPlan devices will use 6 watts (although the units can be run on low power at 1.2 watts). One-way devices do not emit signals and therefore do not expose users to significant electromagnetic radiation. Various studies are underway but for now, consumers should keep abreast of developments.

Certainly more interesting, and arguably as important, is the effect of 24-hour access on the average user. E-mail junkies will be thrilled, at least initially, but eventually users may find themselves in a state of constant attachedness and alertness. They may find that they've traded the confines of their office walls for a kind of perpetual tracking device. This could lead to an undue amount of tension as they choose between the 24-hour access they've paid for and the reality of being accessible morning, noon, and night. On the other hand, the benefit of daily freedom may well be worth it. □

FACT FILE

RAM Mobile Data

RAM Mobile Data, 10 Woodbridge Center Dr., Woodbridge, NJ 07095; 800-662-4839, 908-602-5500; fax, 908-602-1262

RAM Mobile Data's two-way radio network will be able to reach about 90 percent of the U.S. population by the time you read this. The Mobitex network technology, supplied by partner Ericsson GE Mobile Communications, provides unique transparent roaming in which the wireless device automatically reregisters with the RAM network as it moves among transmitter areas and in and out of service areas. The network also stores and forwards messages sent while the unit is off the network. Founded in 1991, RAM was developed specifically as a broad-appeal consumer network, and its services and products are less expensive than those of Ardis, its main competitor. RAM currently transmits at speeds of up to 8 kilobits per second.



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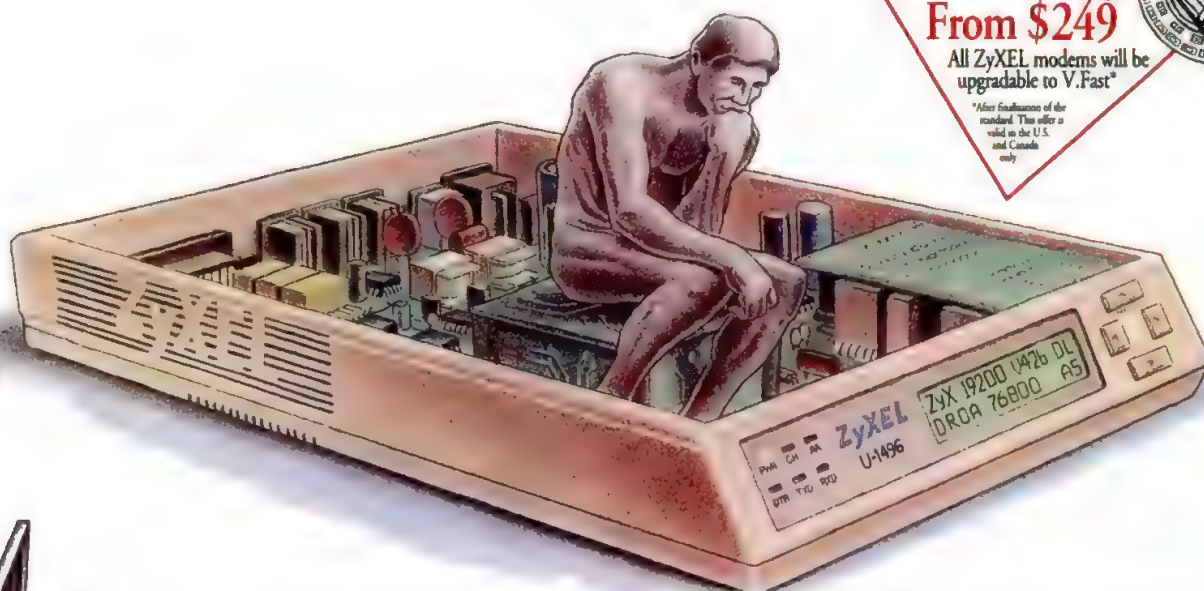


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Adding Comments to Batch Files

BY NEIL J. RUBENKING

ADDING COMMENTS TO BATCH FILES—REVISITED

"Adding Comments to Batch Files" in the December 31, 1991, User-to-User column was very interesting, but you overlooked one method—using a colon to mark comments.

I recreated the three batch files mentioned in that article and tested them for speed. The results were about the same as yours:

- SHORT.BAT 9 seconds
- LONG.BAT 16 seconds
- REMS.BAT 88 seconds

I then copied REMS.BAT to RLABEL.BAT, replaced all occurrences of REM with a colon and a space, and ran the test again. Running RLABEL.BAT took 13 seconds!

I've been commenting batch files this way for several years and never have any problems as long as I remember to put a space after the colon. I never put spaces in real labels.

*M.E. Stokes
Stockbridge, Georgia*

► **PC MAGAZINE:** The article mentioned above describes a technique for embedding long comments in batch files by simply inserting them as text and using the GOTO command to jump over them. It contrasts this with the much slower method of starting each line with the REM command. Many readers have written to say that they gain speed by using a colon rather than REM to start a comment line. This technique works because DOS treats any batch file line that begins with a colon as a *label*, and labels are not executed. REM, on the other hand, is a DOS command, and DOS executes that command whenever it appears. That, of course, takes longer than skipping past a label.

But leaving a space after the colon is not sufficient to prevent DOS from treating your comment as a real label. This fact is demonstrated by the following batch file, LABLTEST.BAT:

```
@ECHO OFF
ECHO Testing the effect of
spaces before a label name.
GOTO This
:      This is just a comment
... or is it??
ECHO If you see this line, the
line above is more than a comment!
:This
:End
```

The supposed comment line has eight spaces between the colon and the word *This*, but DOS still treats it as a label. When seeking a matching label, DOS totally ignores any spaces or other separators between the colon and the label name. In order to safely use the colon to start a comment line, you must follow it with a second colon. A line that begins with two colons is not an executable line, nor is it a valid label.

I created the massive batch file COMNTEST.BAT (Figure 1) to let you perform your own tests of the different methods for embedding comments in batch files. This batch file generates several other batch files for testing purposes:

- \$EMPTY1\$.BAT, a completely empty batch file;
- \$SHORT1\$.BAT, a batch file containing @ECHO OFF, a GOTO command, and the destination label for that GOTO command;
- \$LONG_1\$.BAT, a duplicate of \$SHORT1\$.BAT, but with 256 text lines of about 50 characters each between the GOTO and the label;
- \$REMS_1\$.BAT, a batch file containing the same 256 text lines as

\$LONG_1\$.BAT in the form of REM statements, with no GOTO command to skip over them; and

- \$COLON1\$.BAT, a duplicate of \$REMS_1\$.BAT that replaces each REM with a double colon.

The \$LONG_2\$, \$REMS_2\$, and \$COLON2\$ batch files have twice as many text lines as the corresponding files above, while the \$LONG_3\$, \$REMS_3\$, and \$COLON3\$ files have the same number of text lines, but with the lines twice as long.

Figure 2 shows the result of running COMNTEST.BAT. The double-colon comments turn out to be just a fraction of time faster than the version that uses GOTO to jump over the text! Note that making the lines twice as long and doubling the number of lines have about the same effect on the LONG and COLON versions, but differ for the REMS versions. Doubling the number of lines forces DOS to call the REM command twice as many times, while doubling the length of the lines doesn't change the number of calls to REM.

The purpose of COMNTEST is simply to generate test files and compare their execution times, but it uses some interesting batch techniques to do so. To create the block of text separating the GOTO command from its label in \$LONG_1\$.BAT, COMNTEST first creates the temporary data file TMP1\$.DAT, containing a single line of text. It sets the environment variable *return* to the value Return1 and jumps to the label BuildTemp. Batch lines at this label repeatedly double the size of the temporary file by first concatenating two copies of TMP1\$.DAT into TMP2\$.DAT and then concatenating two copies of TMP2\$.DAT back into TMP1\$.DAT. It's necessary to go back and forth between two files this way because the COPY command won't concatenate a file onto itself.

After eight doublings, TMP1\$.DAT contains 256 copies of the original line,

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and TMP2\$.DAT can be deleted. The next line uses GOTO to jump to the label whose *name* is contained in the e-var *return*. In this case, that name is Return1. The batch file lines between the label BuildTemp and the GOTO %Return% line act as a kind of subroutine, called four times by COMNTEST.

After creating the temporary data file, COMNTEST appends it to the \$LONG_1\$ batch file. It then concatenates another copy of the data file onto \$LONG_1\$.BAT to form \$LONG_2\$.BAT. To create \$LONG_3\$.BAT, it goes through the same process as for \$LONG_1\$.BAT, starting with a line that's twice as long.

All of the text lines in the LONG batch files begin with REM. This doesn't affect their usefulness as text lines, but it makes it very easy to create the REMS versions of the three batch files. COMNTEST.BAT simply passes each of the LONG batch files through the FIND filter, strips out any lines containing Start, and stores the result in the corresponding REMS batch file.

\$COLON1\$.BAT, \$COLON2\$.BAT, and \$COLON3\$.BAT are created in the same way as the LONG batch files. Here the text lines begin with a double colon instead of with REM, and all references to the Start label are omitted. For comparison purposes, COMNTEST also cre-

ates a completely empty batch file called \$EMPTY1\$.BAT.

All the files for testing are now ready; COMNTEST just needs one more file to use in displaying the time. CURRENT.BAT will be invoked by a temporary batch file that executes the output of DOS's TIME command; for example, "Current time is 12:00:06.65a". The time itself becomes the third parameter, and CURRENT.BAT sets the e-var *ctime* to that value. Only the seconds and hundredths of seconds are significant, so the next six lines repeatedly strip the first character from *ctime*. Using the example time shown above, the final value of *ctime* would be "06.65a". I could have

COMNTEST.BAT

Complete Listing

```
@ECHO OFF
:: COMNTEST.BAT - tests speed of different methods for
:: embedding comments in batch files
IF NOT '%1'=='' GOTO OneTest
CLS
ECHO This batch file will reset your system time.
ECHO Press Ctrl-Break to abort, any other key to continue.
ECHO =====
PAUSE > NUL
CLS
ECHO Creating test files...

::Create $SHORT1$.BAT
ECHO @ECHO OFF > $SHORT1$.BAT
ECHO GOTO Start >> $SHORT1$.BAT
COPY $SHORT1$.BAT $LONG_1$.BAT > NUL
ECHO :Start >> $SHORT1$.BAT

::Create $LONG_?$.BAT files
COPY $LONG_1$.BAT $LONG_3$.BAT > NUL
ECHO REM Text Text Text Text Text Text Text Text Text Text> TMP1$.DAT
SET return=Return1
GOTO BuildTemp
:===== Return1 =====
SET return=
COPY $LONG_1$.BAT + TMP1$.DAT > NUL
COPY $LONG_1$.BAT + TMP1$.DAT $LONG_2$.BAT > NUL
ECHO :Start >> $LONG_1$.BAT
ECHO :Start >> $LONG_2$.BAT
ECHO REM Text Text Text Text Text Text Text Text Text Text Text Text Text Text
Text Text Text Text Text Text Text>TMP1$.DAT
SET return=Return1a
GOTO BuildTemp
:===== Return1a =====
SET return=
COPY $LONG_3$.BAT + TMP1$.DAT > NUL
ECHO :Start >> $LONG_3$.BAT

::Create $REMS_?$.BAT files
TYPE $LONG_1$.BAT | FIND /V "Start" > $REMS_1$.BAT
TYPE $LONG_2$.BAT | FIND /V "Start" > $REMS_2$.BAT
TYPE $LONG_3$.BAT | FIND /V "Start" > $REMS_3$.BAT

::Create $COLON?$.BAT files
ECHO @ECHO OFF > $COLON1$.BAT
ECHO :: Text Text Text Text Text Text Text Text Text Text> TMP1$.DAT
SET return=Return2
GOTO BuildTemp
:===== Return2 =====
SET return=
COPY $COLON1$.BAT + TMP1$.DAT > NUL
COPY $COLON1$.BAT + TMP1$.DAT $COLON2$.BAT > NUL
DEL TMP1$.DAT

ECHO @ECHO OFF > $COLON3$.BAT
ECHO :: Text Text Text Text Text Text Text Text Text Text Text Text Text Text
Text Text Text Text Text Text Text>TMP1$.DAT
SET return=Return2a
GOTO BuildTemp
:===== Return2a =====
SET return=

COPY $COLON3$.BAT + TMP1$.DAT > NUL
DEL TMP1$.DAT

::Create $EMPTY1$.BAT
REM > $EMPTY1$.BAT

::Create CURRENT.BAT
ECHO @ECHO OFF > CURRENT.BAT
ECHO SET ctime=%~3>> CURRENT.BAT
ECHO FOR %%v IN (%%ctime%%) DO SET ctime=%%v>> CURRENT.BAT
ECHO FOR %%v IN (%%ctime%%) DO SET ctime=%%v>> CURRENT.BAT
ECHO FOR %%v IN (%%ctime%%) DO SET ctime=%%v>> CURRENT.BAT
ECHO FOR %%v IN (%%ctime%%) DO SET ctime=%%v>> CURRENT.BAT
ECHO FOR %%v IN (%%ctime%%) DO SET ctime=%%v>> CURRENT.BAT
ECHO FOR %%v IN (%%ctime%%) DO SET ctime=%%v>> CURRENT.BAT

ECHO Tests beginning...
ECHO.
FOR %%v IN (EMPTY SHORT LONG_ REMS_ COLON) DO CALL %0 %~1$.BAT %%v
ECHO.
ECHO ===== Now with twice as many lines =====
ECHO.
FOR %%v IN (LONG_ REMS_ COLON) DO CALL %0 %~1v2$.BAT %%v
ECHO.
ECHO ===== Now with lines twice as long =====
ECHO.
FOR %%v IN (LONG_ REMS_ COLON) DO CALL %0 %~1v3$.BAT %%v
ECHO.
FOR %%v IN (1 2 3) DO DEL $?????%%v$.BAT
SET ctime=
DEL CHEKTIME.BAT
DEL CURRENT.BAT
ECHO.
ECHO Remember to correct the system time!
GOTO End

:===== BuildTemp (subroutine)
:: If the REMS test takes over a minute on your machine,
:: delete the next two lines.
COPY TMP1$.DAT+TMP1$.DAT TMP2$.DAT > NUL
COPY TMP2$.DAT+TMP2$.DAT TMP1$.DAT > NUL
COPY TMP1$.DAT+TMP1$.DAT TMP2$.DAT > NUL
COPY TMP2$.DAT+TMP2$.DAT TMP1$.DAT > NUL
COPY TMP1$.DAT+TMP1$.DAT TMP2$.DAT > NUL
COPY TMP2$.DAT+TMP2$.DAT TMP1$.DAT > NUL
COPY TMP1$.DAT+TMP1$.DAT TMP2$.DAT > NUL
COPY TMP2$.DAT+TMP2$.DAT TMP1$.DAT > NUL
DEL TMP2$.DAT
GOTO %Return%

:===== OneTest =====
TIME &
FOR %%v IN (x x x x x x x x x x x x x x x x x x x x x x) DO CALL %1
ECHO.| TIME > CHEKTIME.BAT
CALL CHEKTIME.BAT
ECHO %2 batch file took %ctime% seconds.
:===== End =====
```

Figure 1: COMNTEST.BAT compares the execution time of several different methods for embedding comments in batch files.



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TEST RESULTS

```

EMPTY batch file took 00.32a seconds.
SHORT batch file took 00.49a seconds.
LONG_ batch file took 03.57a seconds.
REMS_ batch file took 22.79a seconds.
COLON batch file took 03.46a seconds.

===== Now with twice as many lines =====

LONG_ batch file took 06.70a seconds.
REMS_ batch file took 45.53a seconds.
COLON batch file took 06.42a seconds.

===== Now with lines twice as long =====

LONG_ batch file took 06.59a seconds.
REMS_ batch file took 30.15a seconds.
COLON batch file took 06.26a seconds.
```

Figure 2: This sample of COMNTEST's output shows that starting comment lines with double colons is *much* faster than starting them with REM.

made CURRENT.BAT sophisticated enough to remove that final *a*, but I didn't think it worth the trouble.

Finally the testing begins! A FOR command processes the five descriptive strings EMPTY, SHORT, LONG_, REMS_, and COLON. For each of these strings, it reCALLs COMNTEST.BAT (represented by the %0 parameter) and

carriage return (produced by the command ECHO). to DOS's TIME command and redirects the output to the temporary batch file CHEKTIME.BAT. When CHEKTIME is called, it in turn executes CURRENT.BAT, which sets the e-var ctime to the number of seconds elapsed since the command TIME 0. The last line reports the name of the batch file and the

passes it a filename created by prefixing a dollar sign to the string and appending \$1.BAT. It passes the descriptive string alone as a second parameter.

When COMNTEST.BAT is called with parameters on the command line, the IF test at the top transfers control to the label OneTest. Batch lines at this label reset the system time to 0 and CALL the specified batch file 25 times. The next line passes a

time it took to execute. Note that the batch lines at the label OneTest serve as another kind of subroutine!

COMNTEST.BAT repeats this process with the test files created using twice as many lines, and using lines twice as long. It then deletes all the files it created, cleans up the e-vars, and terminates.

You can run COMNTEST.BAT yourself to see how the different methods for embedding comments perform. If your machine is substantially slower than the 486/33 I use for testing, you may want to delete the first two executable lines from the BuildTemp subroutine. This will save you time because it causes the test batch files to start with 64 text lines rather than with 128.

You can download the batch files mentioned in this column from the Utilities/Tips Forum on PC MagNet, archived as COMMEN.ZIP. □

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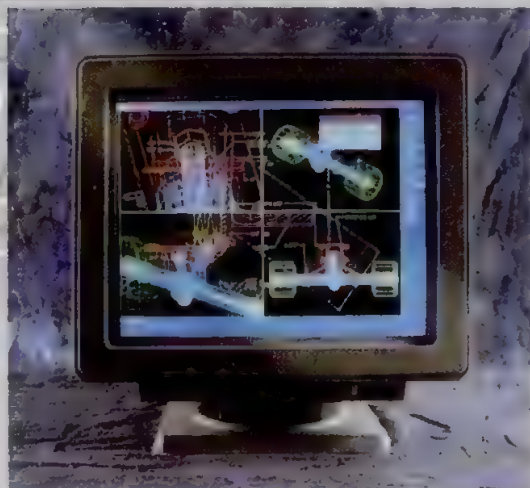
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Vertical Scanning (Hz)	60-100	50-100	50-100	50-100	50-100	50-100
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VESA 800x600@56 60/72Hz	•	•	•	•	•	•
VESA 1024x768@60Hz	•	•	•	•	•	•
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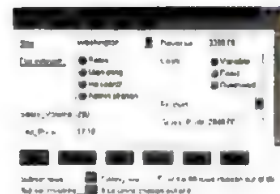
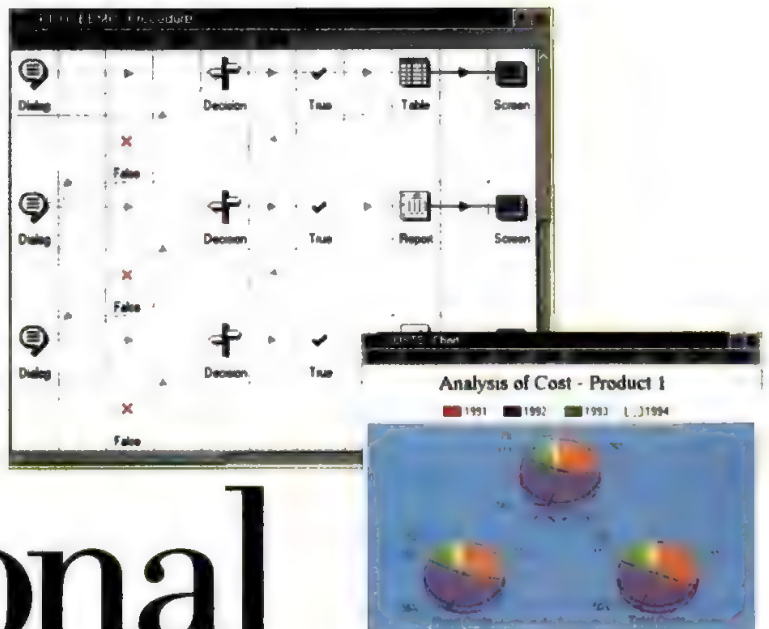
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Maximizing Memory Under DOS 6.0

BY JEFF PROSISE

DOS 6.0 is much more nimble than DOS 5.0 when it comes to handling memory, especially on 386 and 486 PCs. A default installation of DOS 6.0's EMM386.EXE driver provides more upper memory on the vast majority of PCs than a default installation of DOS 5.0's EMM386.EXE driver. The DOS 6.0 version of EMM386.EXE also pools expanded (EMS) and extended (XMS) memory so that you don't have to split available memory between them; EMM386.EXE will dish out RAM to one program as expanded memory and to the next as extended memory. In DOS 5.0, you had to specify how memory would be apportioned when EMM386.EXE was installed. If a program requested EMS memory when there was no more EMS memory, EMM386.EXE would not reallocate XMS memory to create more EMS memory. In DOS 6.0, it will.

The icing on the cake is MemMaker, which modifies your CONFIG.SYS and AUTOEXEC.BAT files to move TSRs and device drivers to upper memory. The process of converting your start-up files to take advantage of upper memory—a highly manual and often confusing procedure in DOS 5.0—requires almost zero effort in Version 6.0.

Still, there are some things MemMaker won't do. If you truly want to maximize the amount of RAM available to your application programs in DOS 6.0, you'll need to do some fine-tuning by hand after MemMaker has run its course. Here are just a few ways you can make more RAM available to RAM-hungry application programs in DOS 6.0.

TRIM THE FAT FROM CONFIG.SYS Converting DEVICE commands to DEVICEHIGH is the obvious way to con-

serve memory through CONFIG.SYS. There are other ways, however, that are not so obvious. For example, if the CONFIG.SYS file on your 286, 386, or 486 PC does not contain a STACKS statement, you're losing almost 2K of RAM that DOS reserves for the purpose of providing additional stack space to hardware interrupt handlers. The extra stack space isn't needed on most PCs, so you can add almost 2K of RAM to the largest execut-

*Here are several ways
you can go beyond DOS
6.0's improved memory
managing facilities to avail
your programs of the
largest possible chunk of
RAM.*

able program size by adding the following statement:

```
STACKS=0,0
```

If DOS subsequently crashes on you after displaying "Internal stack overflow" messages, go back to the original STACKS setting. Note: If EMM386.EXE is loaded and a stack overflow occurs, you may receive an "Exception error 12" message instead of an "Internal stack overflow" message.

Another RAM eater in CONFIG.SYS is the LASTDRIVE statement. LASTDRIVE reserves room for logical drives up to the specified letter, and each logical drive requires 88 bytes of conventional memory. If you reserve space for more

logical drives than you need to, you're wasting memory. CONFIG.SYS files that contain LASTDRIVE=Z statements are almost guaranteed to be wasting RAM. The solution? Set LASTDRIVE equal to the highest drive letter that you actually use, and make sure that all drive letters are contiguous. For example, if your hard disk contains logical drives C: and D: and you assign a pair of network drives the letters M and N, change M and N to E and F (and set LASTDRIVE=F) and you'll add more than 700 bytes to the largest executable program size.

Other notorious RAM eaters are the FILES and BUFFERS statements. On a 286 or higher, make sure CONFIG.SYS contains a DOS=HIGH statement and a DEVICE= statement loading HIMEM.SYS so that DOS will be loaded high (in the HMA), and set BUFFERS to 40 or less. This will ensure that DOS's disk buffers go in the HMA alongside the DOS kernel. As for FILES, experiment with different settings to determine how little you can get away with. If you have a 386 or 486, you can use PC Magazine's UMBFILES utility (available on Ziff-Net) to move most of the system file table (SFT) to upper memory. Installing UMBFILES on a PC that uses a setting of FILES=40 adds about 2K to the largest executable program size. If your FILES= setting is larger, you'll save even more by switching to UMBFILES.

If none of your programs use file control blocks (data structures used to store information about files in early versions of DOS), you can save a few more bytes of RAM by adding the statement

```
FCBS=1
```

to CONFIG.SYS. And if CONFIG.SYS contains a SHELL statement loading COMMAND.COM with a /E switch

increasing the environment size, use the SET command to determine if you really need all that environment space. At the command prompt, type

```
SET > ENVSIZE.$$$
```

Then type

```
DIR ENVSIZE.$$$
```

The size of ENVSIZE.\$\$\$ is a pretty good indicator of the number of bytes of environment space that are currently in use (for an exact count, subtract the number of environment variables from the file size and add 1). If this size is substantially less than the amount of environment space you set aside with the /E switch, decrease the environment size accordingly. Afterward, if you receive "Out of environment space" messages when you run batch files, increase the environment size until the messages go away.

OPTIMIZE THE LOAD ORDER MemMaker uses a process called *bin packing* to determine into what regions of upper memory TSRs and device drivers should be loaded so that an optimal fit is achieved. For example, suppose you have a 4K UMB and a 2K UMB, and you want to load two 1K programs and a 3K program. If you put the two 1K programs in the 4K block, you won't be able to load the 3K program. MemMaker, though, is smart enough to put the two 1K programs in the 2K block, leaving the 4K block to hold the 3K program. If space in upper memory is tight, this could allow you to cram more TSRs and device drivers into upper memory.

Sometimes changing the order in which TSRs and device drivers are loaded will allow more of them to be loaded high, because some programs require more memory than their installed sizes indicate. For example, a TSR with an installed size of 20K could require a total of 40K immediately after it is loaded (the additional 20K might serve as buffer space). This TSR couldn't be loaded in a 50K UMB that already contained a 20K TSR, but it would load if it were loaded *before* the 20K TSR. MemMaker won't alter the load order itself. It can't: Too often the effectiveness of a TSR or device driver is dependent upon its position in

CONFIG.SYS or AUTOEXEC.BAT.

If you're just a few kilobytes short of having enough upper memory to load one last TSR or device driver high, you may be able to fit it in by optimizing the load order—shuffling the order in which TSRs or device drivers are loaded so that those with the biggest difference between maximum size and installed size are loaded first.

How do you determine what the maximum and installed sizes are? Simple. Af-

*Sometimes changing the
order in which TSRs and
device drivers are loaded
will allow more of them to
be loaded high.*

ter running MemMaker, inspect the file named MEMMAKER.STS left behind in the directory where MemMaker itself is stored. For each TSR and device driver that it loads, MemMaker writes entries to this file denoting the maximum size (MaxSize) and installed size (FinalSize). To the extent possible, reorder commands so that programs exhibiting the greatest difference between MaxSize and FinalSize are loaded first. Then run MemMaker again to see if your changes made a difference.

Another way to squeeze out a few more kilobytes of upper memory is to start EMM386.EXE with a NOHI parameter. This prevents EMM386.EXE from loading part of itself into upper memory (by default, about half of EMM386.EXE goes into upper memory to reduce the driver's footprint in conventional memory). NOHI causes EMM386.EXE to use about 5K of conventional memory, but if an extra 5K of UMB RAM enables you to load a 40K TSR high, then you added a net 35K to the largest executable program size.

USE THE C000H AND F000H SEGMENTS By default, neither MemMaker nor DOS 6.0's EMM386.EXE driver will convert empty space in the range C000h to C5FFh to UMB RAM on ISA-bus PCs. You can use MSD (the Microsoft Diagnostics util-

ity bundled with DOS 6.0) to determine whether your PC contains unused address space in this region and, if it does, use an I= switch to convert the empty space to UMB RAM. Start MSD and press M to display a map of upper memory. If the memory map reveals that segment addresses C000h through C5FFh are empty, add an I=C000-C5FF switch to the line that loads EMM386.EXE. Doing so will provide DOS with an additional 24K of upper memory. If only part of the address range C000h to C5FFh is empty, adjust the I= switch accordingly. For example, if MSD reveals that segments C000h through C3FFh contain ROM but that segment addresses C400h through C5FFh are devoid of RAM and ROM, add an I=C400-C5FF switch to the line that loads EMM386.EXE to create an additional 8K of UMB RAM.

DOS 6.0's EMM386.EXE stops its scan of upper memory for unused address space at segment EFFFh. You can extend the search to segment F7FFh by starting EMM386.EXE with a HIGHSCAN parameter. MemMaker will add this parameter for you, so if you've already run MemMaker, you shouldn't have to worry about it. Watch out, though: HIGHSCAN locks up some PCs. The easy way to recover is to perform a *clean boot* (DOS 6.0 lets you bypass CONFIG.SYS and AUTOEXEC.BAT by pressing F5 during startup). Then edit CONFIG.SYS to remove the HIGHSCAN switch.

DELETE WIN= SWITCHES If you allow MemMaker to optimize your system for DOS applications run under Windows 3.1, it may add one or more WIN= switches to the statement in your CONFIG.SYS file that loads EMM386.EXE. WIN= is similar to X= in that it blocks out regions of memory so that they won't be used by EMM386.EXE. Regions reserved with WIN= are used to hold Windows' translation buffers—areas below 1MB that are used to pass data between protected-mode Windows and real-mode DOS.

The problem is that if EMM386.EXE is started with one or more WIN= switches and you don't boot Windows, you're potentially robbing DOS of several kilobytes of UMB RAM. The solution is simple: Use DOS 6.0's multiple configurations feature to set up two sepa-

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rate configuration blocks in CONFIG.SYS—one that configures your PC to run Windows, and one that configures it to run DOS. Delete the WIN= switches from the DOS configuration. Remember to modify your AUTOEXEC.BAT file to support the dual configurations.

ELIMINATE THE EMS PAGE FRAME While you're modifying your start-up files, remember that configuring EMM386.EXE as an EMS provider takes away 64K of UMB RAM to serve as an EMS page frame. If none of your programs uses expanded memory, load EMM386.EXE with a NOEMS switch to do away with the page frame. If just one or two programs use expanded memory, you might elect to use the multiple configurations feature to set up one set of configuration statements that loads EMM386.EXE with a RAM switch and another set that loads it with a NOEMS switch. Then you could reboot and select the RAM configuration prior to running an EMS-aware application program.

With some applications, you can have your cake and eat it too. If an EMS-aware program was written to Version 4.0 of the EMS spec, then, depending on how it was written, it may not require a page frame. It's possible to transfer data to and from EMS 4.0 expanded memory directly, without using a page frame as an intermediary. You can configure EMM386.EXE as an EMS emulator and do away with the page frame by adding a FRAME=NONE switch, as in

```
DEVICE=C:\DOS\EMM386.EXE RAM
FRAME=NONE
```

This enables EMM386.EXE to serve up expanded memory to programs that need it, without impacting available UMB RAM. Try it; if your apps don't complain, then you've just saved yourself 64K of memory. If an EMS-aware application crashes or complains that it was unable to locate the page frame, remove the FRAME=NONE switch. FRAME=NONE works in DOS 5.0, too, although this fact was not documented.

As you can see, there's more to optimizing RAM usage under DOS 6.0 than just running MemMaker. MemMaker is a good start, but it's up to you to squeeze out the last drop of memory. □



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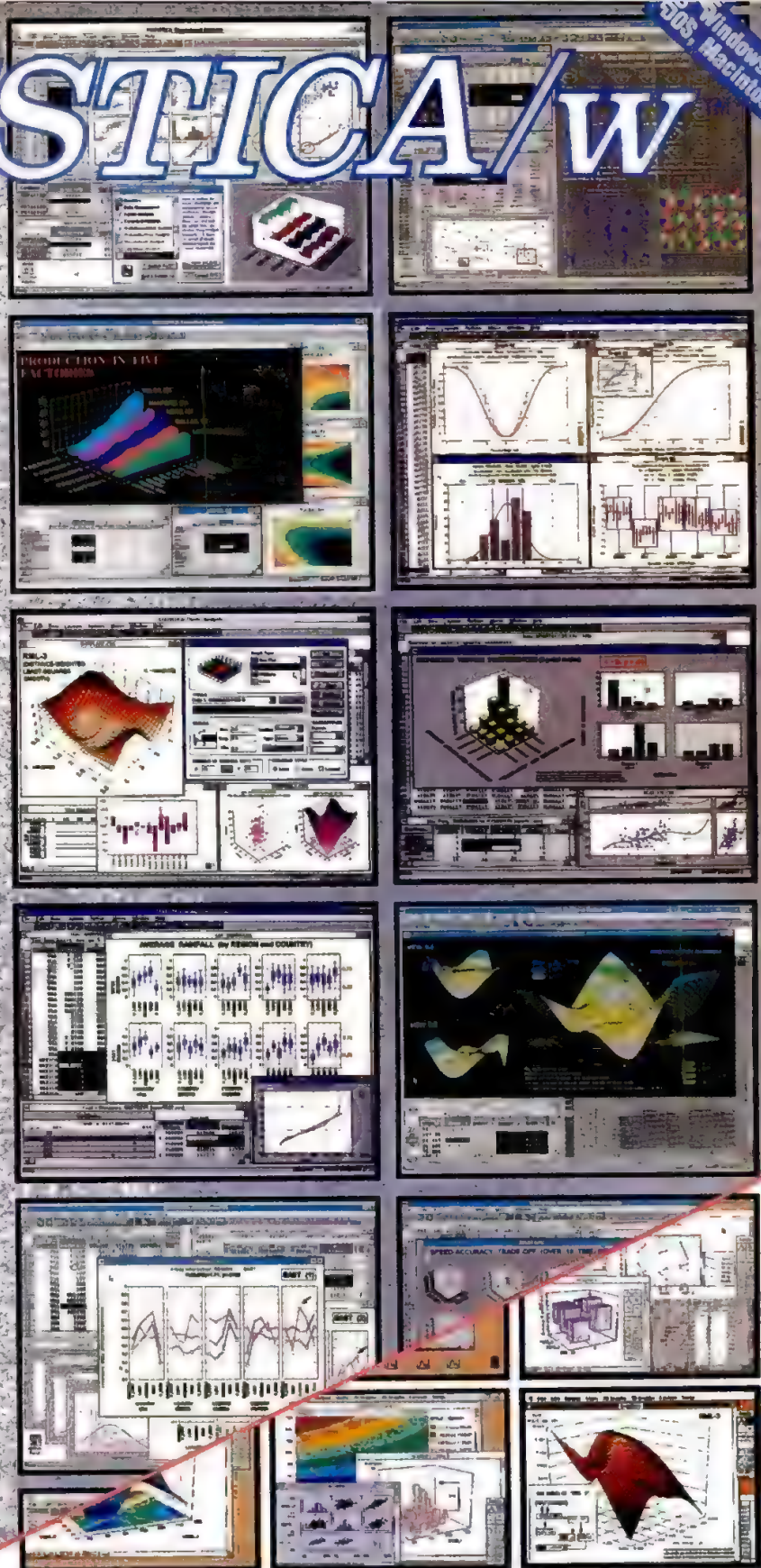


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Techniques That Make FoxPro Programming Easier

BY JIM KORENTHAL

If database programming is an important part of your world, you may have already upgraded to the new FoxPro 2.5 (First Looks, April 13, 1993). FoxPro is now a very rich programming system with editing, debugging, reporting, and project management tools that are every bit as powerful and complete as any you'll find in the non-Xbase world.

This two-part Lab Notes will present a variety of techniques that work in Versions 2.0 and 2.5, which will help your programs build upon FoxPro's strengths and minimize its weaknesses. And if this is your first exposure to the language, you'll be able at least to sample its flavor.

MANAGING SNIPPETS The first technique I'll discuss involves a Fox programming approach you'll find useful in any application you write. To facilitate application development, FoxPro 2.0 introduced a set of Power Tools, the most important of which is the Screen Builder. When using the Screen Builder, you develop your application first by designing a user interface and then by supplying the program code that makes each interface element perform its particular function.

The Screen Builder uses an event-driven model: You place an object on the screen with a menu or a graphic toolbar and then detail how it is to react under various conditions, or *events*. For example, you'd write a WHEN clause to describe what happens when the cursor enters a field, and a VALID clause to specify the actions to be taken when the cursor leaves that field.

Although an event-driven model is intuitive and especially well-suited for some programming tasks, it has its disadvantages. Programs written with the Screen Builder consist of little *snippets* of code, each containing the instructions for

a particular event. If you want to see your code, you must go into the Screen Builder and open up your snippets. You can then look at the Screen Builder's output—a text file that includes all your snippets—but you can't edit the text file and reintegrate the code into the Screen Builder as snippets. Since complex applications may contain many hundreds of snippets, this can make code management difficult.

Moreover, snippet programming increases compile time. The Screen Builder keeps every snippet in a database, together with the application's interface elements. When you build your applica-

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tion, the Screen Builder uses this database to generate a single, large source program to be compiled. Since everything is integrated, the entire application must be rebuilt each time you make any change to your program.

There is a way to retain the advantages and eliminate the disadvantages of snippet programming, however. You just define each snippet as a function call in the Screen Builder (giving it any reasonable name you choose), and then put these functions in one or more external .PRG (FoxPro program) files.

FoxPro's Project Manager keeps track of all the components that go into an application—screens, menus, reports, databases, and user-written programs, for example. Since there's no main() function

or other assumed program entry point in FoxPro, you must specify a *start-up file* to tell the Project Manager which program to execute first. This would normally be the code generated by the Screen Builder, but to implement this technique, you make your .PRG the start-up file instead.

For example, suppose you had a push button on the screen called MyButton. To specify what happens when the mouse is clicked on MyButton, you might write the following VALID clause in the Screen Builder:

```
MyButtonPush()
```

Now you write a .PRG file "sandwich" that calls your screen code:

```
... any setup code you wish ...
do MYSCREEN.SPR  && assumes your
screen is called MYSCREEN
... any cleanup code you wish ...
Function MyButtonPush
... the "real" code for the snippet
*end function MyButtonPush
... more snippets and functions ...
```

When using snippets, your VALID clause is defined as a Procedure. Ordinarily, when substituting a function call, you'd select Expression instead. But if you do so, you'll no longer be able to use the Open All Snippets option to see where the code is attached to your interface. To avoid this difficulty, you can leave the clause defined as a Procedure and then write

```
return MyButtonPush()
```

In effect, this gives you a pseudo-snippet that allows you to continue using the Open All Snippets option.

Whether you define it as a Procedure

or an Expression, by making your snippet a function call within a program, the screen code will not be recompiled each time you alter your snippet code. Further, you can edit all the snippets in the .PRG at one time, using either FoxPro's own or an external editor. Indeed, if you're in Windows, DESQview, or any environment that supports task switching, you can even edit externally while the Screen Builder is running. This makes for a very productive development environment!

Note, too, that you can extend this concept to multiple .PRG files, which will allow you to organize your program into logical function groups and to create function libraries that can be used by multiple applications.

DATA ENTRY WITH A BIAS A second ingenious technique was suggested by Richard Hurd, on CompuServe's FoxForum. Let's suppose that your users are entering part numbers into an 8-character field and that many of these part numbers begin with the same set of digits. All Widgets, for example, might start with 8523 and all Gadgets with 912506. You can speed up data entry and eliminate many typing errors if the operator can type w42 instead of 852342 and g57 rather than 91250657.

It would be easy enough to do this after each entry simply by scanning what has been typed in and replacing the entered field. But wouldn't it be nice if the operator could get immediate feedback, seeing 912506 appear on the screen right after typing the letter g? That kind of entry is called *data biasing*; the first letter typed biases the rest of the entry.

The obvious way to implement data biasing is through the Inkey function. Since Inkey reads only one character at a time, however, this would be cumbersome to implement. Instead, you can split the field into two immediately adjacent fields that will appear as one. You make the first field only one character wide so that any associated VALID clause will be executed as soon as the first character is typed. You can then use the VALID clause in order to make immediate substitutions.

Thus, in terms of the illustration above, instead of using one eight-digit PartNum field, you would create a one-

character Part1 field and a seven-character Part2 field. The Part1 validation routine (with a support function) might resemble the code listed in Figure 1.

You can add more bias codes to this routine very easily. It's also easy to modify the routine to support more than one coded section within the field or to allow bias codes of more than just a single character.

As a side note, the Case statement that appears in Figure 1 illustrates an interesting coding technique. It keeps testing the bias codes until the first test succeeds, after which it skips the rest of the tests. This is definitely preferable to using nested IFs. Multiple IFs are cumbersome in FoxPro because its language lacks an ELSE IF construction. Even worse, of course, would be to allow all the tests to be executed even when the first one has succeeded.

EXTENDING VARREAD() FoxPro's VarRead() function reports the name of your current editing field. The documentation for the function discusses its use in a context-sensitive help system, but you can use VarRead() for a great deal more. One useful technique is to use VarRead()—along with FoxPro's Eval()—to apply a single validation routine to multiple fields.

Suppose, for example, that you have a single-character field called PayType in your invoice database. In this field you want to store the pay types Not Paid, American Express, MasterCard, Visa,

Check, or Cash as " ", "A", "M", "V", "C", or "\$", respectively. The FoxPro validation routine might look something like this:

```
function payTypeValid
    return invoice.payType $ " AMVC$"
*end function payTypeValid
```

Now change the function slightly, to

```
function payTypeValid
    return eval("invoice."+VarRead())
    $ " AMVC$"
*end function payTypeValid
```

This function first constructs the name of the desired field by appending the result of VarRead() to the table name, and then calls Eval() to get the value of that field. The \$ operator checks whether the value occurs in the quoted string; it returns .T. if the value is found, otherwise it returns .F.

It's just as easy to write the function this way, but now it will work for *any* field in the database that requires this type of validation!

VarRead() is a very versatile function. The whichOne() function uses Varin the following code, Read() to return the current subscript when processing array variables. Using the whichOne() function as a support function, you can use one validation routine for all the elements in an array. It assumes the cursor is on a subscripted variable.

PART1VALID

Partial Listing

```
function Part1Valid
do case
    case partBias("w", "8523")
    case partBias("g", "912506")
    case ... (as many bias codes as needed)
endcase
*end function Part1Valid

function partBias
parameter biasCode, partCode
if Part1 = biasCode
    Part1 = left(partCode,1)
    Part2 = substr(partCode,2)
    show get Part1
    show get Part2
    return .T.
endif
return .F.
*end function changePart
```

Figure 1: With data biasing entry, you can save many keystrokes and errors by letting a single letter represent a sequence of often-repeated digits.

DATE VALIDATION ROUTINE

Complete Listing

```

function dateValid
parameter which  && "which" is the name of the passed date field
private memName, memXname, fieldName
private t, d, year, j, u
memName = "m." + which          && name of data entry field
memXname = "m.x" + which        && name of saved last value field
fieldName = "invoice." + which  && name of field in database

* The above statement assumes that all fields are in
* a database called "invoice." Of course we could further
* generalize the routine by supplying the database alias
* name in a second argument to dateValid().

t = alltrim(eval(memName))      && t = value entered by user
if t = "."                      && if user just typed a period,
    t = eval(memXname)          && replace field with value saved
endif                           && last time for this field

* Don't process further if the field is empty or if there
* are already two slashes (denoting mm/dd/yy) in the field

if !empty(t) and at("/",t,2) = 0
    j = at("/",t)                && j = position of slash or 0 if none
    * If there's a slash with other material both before and after
    * it, remove the slash and retain the next two characters after
    * the slash--or if there's only one character after the slash,
    * add a "0" in front of that character. This normalizes "m/d"
    * or "m/dd" to "mdd" and "mm/d" or "mm/dd" become "mmdd".

    if j > 1 and len(t) > j
        t = left(t,j-1) + padl(substr(t,j+1),2,"0")
    endif
    j = len(t)                  && j = length of what's left
    year = "/" + right(dtoc(date()),2)

    * set up "year" as "/93" (or whatever the current year is)

    do case
        case j < 3  && change "m" or "mm" to "mm/01/yy"
            t = t + "/01" + year
        case j < 5  && process "mdd", "myy", "mmdd" or "mmyy"
            u = right(t,2)  && get the month or year part

            * this creates "mm/dd/yy" or "mm/01/yy" if mmyy entered

            t = left(t,j-2) + if( val(u) < 32 , "/" + u + year , ;
                                "/01/" + u )
        case j < 7  && process "mddy" or "mmddy"
            * this creates "mm/dd/yy"

            t = left(t,j-4) + "/" + substr(t,j-3,2) + "/" + right(t,2)
    endcase
endif
d = ctod(t)                    && ask FoxPro if we now have a valid date
if empty(d) and !empty(t)
    return .F.                  && and fail if we don't
endif
if !empty(t)                   && if the entered date isn't empty, save
    store t to (memXname)       && it for possible "." entry next time
endif

* Store blanks (no slashes!) or mm/dd/yy to the character field

store if(empty(d), repl(" ",8), dtoc(d)) to (memName)
show get (memName)              && update the field on screen
if d != eval(fieldName)        && update the database field if changed
    replace (fieldName) with d
endif

*end function dateValid

```

```

function whichOne
return Val(substr(VarRead(),At
(" ",VarRead())+1))
*end function whichOne

```

The user-defined whichOne() function incorporates a number of built-in FoxPro functions. VarRead() here will return the complete field name, including the subscript, for example, PAYTYPE (12). The At() function points to the first character position of the subscript, and the substr() function returns the rest of the string from that point—5 12) in this example. The Val() function evaluates a number up to the first non-digit. Thus 5) evaluates to the integer 5, which is the value returned by the whichOne() function.

The whichOne() function can have many additional uses. In the next issue I'll present a routine that uses whichOne() to save screen space by sharing a single list box among many different fields.

EASIER ADDRESS ENTRY Consider next an address block that consists of a name line, followed by four possible address lines (called Addr1 through Addr4), followed by a City/State/Zipcode line. It would certainly speed up data entry considerably if you could force the cursor to skip Addr2, Addr3, or Addr4 whenever the previous line was blank. Here's one way to do it.

First, make the WHEN clause, which is executed on field entry, for each of Addr2, Addr3, and Addr4, as follows:

```
checkAddr()
```

Now write the checkAddr() function itself:

```

function checkAddr
return !Empty(Eval("Addr"+Str
(Val(Right(VarRead(),1))-1,1)))
*end function checkAddr

```

The complexity of this return function calls for a little explanation. Assume that Addr2 is being processed, so that the VarRead() function returns Addr2. The Right() function returns the rightmost character of this string, which in this case is 2. Then the Val() function converts this into a numeric so we can subtract 1 from

Figure 2: This enhanced date validation function lets you use a variety of shortcuts when you are entering date fields.

it, and the Str() function converts the result of the subtraction (in this case, 1), back into a string. This is then concatenated with Addr, resulting in Addr1, whose value is then evaluated.

If Addr1 is not empty, .T. is returned, telling FoxPro it should enter the Addr2 field. If Addr1 is empty, however, an .F. is returned and Addr2 is skipped. FoxPro then does similar processing on Addr3 and Addr4. Since these have the same WHEN clause, the cursor will wind up on the next field following Addr4. Neat!

GETTING A SMART DATE FoxPro itself provides a number of functions for automating data entry and validation, but sometimes a little additional coding can reap significant rewards in terms of data entry time and accuracy.

Date field entry in FoxPro is simple and straightforward: You simply put a date field on the screen and let the user type into it. FoxPro will complain if an invalid date is entered, so what more do you need?

A few refinements may still be in order. One would be to remove the slashes

FoxPro displays for an empty date field, thus making a line with a number of empty fields look completely empty. Another would be to assume the current year if the user types mm/dd. (The yy, mm, and dd variables signify two-digit years, months and days, and m and d designate one-digit months and days, respec-

***FoxPro provides a
number of functions for
automating data
entry and validation.***

tively.) Data entry can also be made faster by allowing users to enter dates in the form mddy, or by letting users type a period when they want to reuse the last date entered. Another enhancement is to let users type m/yy or myy for the first day of the month when yy > 31 (the > 31 proviso prevents confusion of myy with mdd.)

You can do all this and more with the function presented in this section. Suppose you have the fields orderDate, shipDate, and payDate in your database. A little code added to the program's initialization section will define a few variables and initialize each of them to eight spaces:

```
public m.orderDate, m.shipDate,
      m.payDate
store repl(" ",8) to
      m.orderDate, m.shipDate, m.payDate
public m.xOrderDate, m.xShipDate,
      m.xPayDate
store repl(" ",8) to m.xOrderDate,
      m.xShipDate, m.xPayDate
```

You then set up the m.orderDate, m.shipDate, and m.payDate variables as character data entry fields in FoxPro's Screen Builder. The fields' VALID clauses are defined in the following way:

```
dateValid("orderDate")
dateValid("shipDate")
dateValid("payDate")
```

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You then enter the general validation routine shown in Figure 2. Admittedly, it's quite a bit of code, but you have to write it only once and you can use it when entering dates in all your applications. With a little bit of extra work, you could process special entries, such as "today," "yesterday," "+15" (to mean 15 days from now), or anything else you chose. You could also use the VarRead() function to avoid having to pass the field name.

ENHANCING THE BROWSE COMMAND

Now let's turn from considering data entry techniques to looking at some of the data that has been entered. With FoxPro's powerful Browse command, it's possible to write a single line of code that accomplishes what would take pages to code in some other languages. Even so, you'd often like to see more data on the screen than Browse presents.

Suppose you have fields for Company, LastName, and FirstName in a Customer database. Any of these fields may be blank, and it wastes space to display all three fields in a fixed format with the Browse command. The function shown in

Figure 3 combines all three of these fields into one, using a field length you've judged to be wide enough to display the combined data. (Should you misjudge, FoxPro will automatically scroll horizontally if the field is too short.)

The whoIsIt() function returns a nicely formatted string that consists of the company name (if present), followed by the personal name in parentheses (again, if present). Note the use of the iif() function in this routine. In FoxPro, iif(A,B,C) evaluates expression A and returns B if A is true and C if A is false. I'll explore the use of this powerful

function further in Part 2. To use whoIsIt() in the Browse command, enter

```
Browse fields Customer.Code, Who =
  whoIsIt():40, Invoice.InvCode
```

This tells FoxPro to display the whoIsIt contents in a 40-column field and to put the title Who at the top of the field.

CLEANING UP IN WINDOWS The next trick applies only to FoxPro for Windows, Version 2.5. Suppose you're updating your customer database and you start up another application. Something could go wrong—the power might fail or your

WHOISIT

Complete Listing

```
function whoIsIt                && returns customer company and name
  private name, firm
  firm = iif( empty(Customer.Company), "", trim(Customer.Company) )
  name = iif( empty(Customer.LastName), "", ;
    "(" + trim(Customer.FirstName) + " " + ;
    trim(customer.LastName) + ")" )
  return alltrim(firm + " " + name)
*end function whoIsIt
```

Figure 3: This whoIsIt() function saves screen display space by combining multiple fields into one when one or more of the fields is blank.

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YESNO

Complete Listing

```

function yesNo
  parameter question
  private c
  c = ""                && make sure a key is really pressed
  do while "" = c      && (c will be "" if the mouse was clicked)
    do beep
      wait window question + "? (Y/N)" to c
    enddo
  return upper(c) = "Y"  && allow either "y" or "Y" response
*end function yesNo

```

Figure 4: This function retrieves a Yes/No answer from the user.

MOVE POPUP ITEMS INTO MEMORY

Complete Listing

```

select 0                && get to a free work area
use Products            && use the reference table
dimension prodArray(reccount()) && set up an array to hold the table
scan                   && scan the entire table
prodArray(recno()) = Product + " " + Descript && fill the array
endscan

```

Figure 5: This code reads the values from an external database into a memory array when FoxPro initializes, speeding pop-up list display.

computer could crash—before you returned to FoxPro. If your application was in an unstable state, it's possible that data loss could occur that could easily have been avoided by doing a little cleanup before minimizing FoxPro.

The way to accomplish this is by providing a button in the application that minimizes all of FoxPro, but only *after* the cleanup is done. You click on this button instead of using the minimize arrow in the upper-right-hand corner of the FoxPro window. This function, which would be used as your buttons VALID clause, was suggested on FoxForum by Lou McDonald. It takes advantage of the undocumented Screen option of the Zoom Window command which minimizes the FoxPro screen. He used the FoxPro Flush command as our cleanup code; you could add additional statements as needed.

```

function Iconize
  flush
  ...other cleanup code...
  zoom window screen min
*end function Iconize

```

There's another way to accomplish the same result, and I'll present it here because it hints at the versatility of the Keyboard command, which stuffs the keyboard buffer:

```

function Iconize
  flush
  keyboard "{Alt-F}{leftarrow}"
*end function Iconize

```

This function works by opening up the control menu in the FoxPro window and then issuing the n command to cause the window to minimize. You would normally open the control menu from the keyboard by typing Alt-space, but since you can't get this keystroke combination through the Keyboard command, you instead have to issue an Alt-F command, which opens the FoxPro File menu. Then, since the File menu is the first item, you go left one position to open the control menu.

Admittedly this method is a kludge, and it won't work when the system menu isn't active or if an application has changed the system menu so that the File menu isn't first. But it shows how you can get around some of FoxPro's limitations by judicious use of the Keyboard command.

MAYBE YES, MAYBE NO Despite its powerful interface functions, FoxPro lacks an easy way to retrieve a Yes/No response from the user. The following function pops up a window, beeps the speaker, and waits for the user to type a Y for Yes or anything else for No. The function re-

turns .T. for a Yes response and .F. for a No response. You'd use the function like this:

```

if yesNo("Delete this record")
  ... (commands to do the deletion)
endif

```

The function itself is listed in Figure 4. Note that there is one minor difficulty: You don't want the routine to exit until the user presses a key, but unfortunately, a WAIT window will also close on a mouse click. While you can't prevent this, the yesNo function solves the problem by redisplaying the WAIT window until a key is pressed.

SNAPPY POP-UP LISTS It's very useful to be able to present a pop-up list of values from a database. You might, for example, have an order entry system that pops up a list of products stored in a separate database. The usual method involves reading from the database each time you pop up the list. (You use FoxPro's Define Popup statement with the Prompt Field option.) But reading from disk can be interminable.

Tina Newton suggests a technique that will make your popup lists much snappier. The trick is to read the reference file with the list items into a memory array as part of your program initialization. You can then pop up the array instead of the records from the file. The code for doing this is shown in Figure 5. Now you can use the Screen Builder's Array Option for pop-ups to quickly display the list. Note that each element of the popup array contains more than just a product name; in the next issue, I'll show you how the additional information can be used to update fields that are not directly tied to the list box.

In the next installment of this column, I'll expand on the techniques shown here and offer additional ones to make your database applications easier to program and to use. When solving problems in FoxPro—or in any other programming language—there's almost always more than one way to skin a cat...or catch a fox! □

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FINDEXEC Locates the Program That Will Run

BY DOUGLAS BOLING

FINDEXEC locates a file—and its DLLs—that will execute in response to your command under DOS, OS/2, or Windows.

Have you ever entered a program name at the command prompt only to find yourself running a different application than you expected? The same DOS PATH variable that lets you run programs without specifying their directories can necessitate a tedious search if you have to track down a same-named application located somewhere earlier on the PATH than the program you intended to execute.

FINDEXEC, this issue's free utility, does the searching for you. It prints out the location of a program without executing it. The utility is unusual in that it is operating-system neutral: You can run it from a DOS or OS/2 command line or from a Windows DOS box and it will adjust its search method for the operating system in use. (The one restriction is that since FINDEXEC is a character-mode application, you must be in character mode rather than in graphics mode.) Because Windows and OS/2 programs usually require dynamic link libraries (DLLs), FINDEXEC also reports the locations of any libraries needed to run those programs.

Getting a copy of FINDEXEC is almost as easy as running it. Both the executable program and its C language source code can be downloaded from PC MagNet's Utilities/Tips Forum archived as FINDEX.ZIP. See the sidebar "PC MagNet: Utilities and More" for the details. Compiling the FINDEXEC source is a little more involved than is usual for PC Magazine utilities, so I'll discuss this issue toward the end of the article.

If you don't have a modem, you can still get the FINDEXEC files without charge, directly from PC Magazine. Just send a postcard with your name, address

and disk-size preference (1.44MB or 1.2MB) to the attention of Katherine West, PC Magazine, One Park Ave., New York, NY 10016. No phone calls, please!

USING FINDEXEC Whether you run FINDEXEC under DOS, OS/2 1.x, OS/2 2.x, or from a Windows DOS box, its syntax is the same:

```
FINDEXEC [/W] [/V | /Ln] [/?]
program_name
```

For example, when I enter

```
FINDEXEC COMMAND
```

at my DOS prompt FINDEXEC returns the line

```
DOS program: C:\DOS50\COMMAND.COM
```

FINDEXEC generally defaults to the search method used by the operating system in use. I'll discuss these in some detail below. In the case of Windows, the FINDEXEC default uses the DOS search procedure, since many times you may want a conventional DOS check from a Windows DOS box. By using the /W command line switch, however, you can tell FINDEXEC to use the specific Windows search method instead. In that case, FINDEXEC depends on the win-

dir= environment variable to locate the Windows directory. Since this environment variable is present only in a Windows DOS box, the /W switch should not be used anywhere else. If the /W switch is used when Windows is not running, FINDEXEC displays an error message.

A FINDEXEC search under Windows or OS/2 does not end with the finding of a designated Windows or OS/2 program. Rather, FINDEXEC goes on to examine the .EXE file to determine which DLLs are required to run the program properly. FINDEXEC then searches for and reports the locations of these additional necessary files.

Again using my machine to illustrate, the command

```
FINDEXEC klondike
```

when executed from an OS/2 window, reports the following:

```
OS/2 2.x Program:
C:\OS2\APPS\KLONDIKE.EXE
```

Top 10 Utilities	
Rank	Utility
1	DIRMATCH - Compare 2 directories
2	BAT2EXEC - Batch file compiler
3	CHKFRAG - Checks fragmentation
4	PCSPool - Print spool utility
5	INCTRL - Installation control
6	BUGS - Windows 3.1 screen saver
7	WINCMD - Command file interpreter
8	STRINGS - Enhance batch files
9	WPRINT - Print in Windows 3.1
10	CLIPST - Extend the clipboard
This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "PCMagNet: Utilities and More."	

Loads:
 OS/2 DLL: DOSCALLS
 OS/2 2.x DLL: C:\OS2\DLL\PMGPI.DLL
 OS/2 2.x DLL: C:\OS2\DLL\PMWIN.DLL
 OS/2 2.x DLL: C:\OS2\DLL\PMSHAPI.DLL
 OS/2 2.x DLL: C:\OS2\DLL\HELPMGR.DLL

Notice in the above list that KLONDIKE must load a DLL called DOSCALLS, but that FINDEXEC did not report its path. The reason is that there is actually no such file, so there is no path to it. When OS/2 starts, it loads its main operating system DLL by reading from one of a set of DLLs. Once in memory,

the resulting DLL is simply *called* DOSCALLS, and FINDEXEC does all that it can by indicating that the program needs this unusual DLL.

A similar situation arises with Windows programs. Once Windows is loaded, KERNEL.DLL and DISPLAY.DLL are in memory, but there are no actual files named KERNEL or DISPLAY for FINDEXEC to locate. So again, the utility simply prints out a line indicating that the program requires these DLLs.

Fortunately, it doesn't matter that FINDEXEC can't print a path to these

particular DLLs. Since Windows can't run without KERNEL and DISPLAY, and OS/2 requires DOSCALLS, if Windows or OS/2 can run, the requisite DLLs are available. (Windows can't run without other DLLs such as USER and GDI. Remember, though, that the problem isn't that KERNEL and DISPLAY are required files, the problem is that there is no file called KERNEL.DLL or DISPLAY.DLL.)

Dynamic link libraries under Windows or OS/2 may require DLLs of their own in order to run. Thus, since there may be a DLL that cannot load because one of its necessary DLLs is missing, FINDEXEC can also search for every DLL required by every DLL! The /Ln and /V switches control how much information FINDEXEC prints for each of the required DLLs.

The /Ln switch tells FINDEXEC to descend to level *n* before ending its search. Using the switch /L3 will cause FINDEXEC to display all the DLLs required by the executable file, its required DLLs, their required DLLs, and *their* required DLLs!

For example, on my system, entering the following line

```
FINDEXEC /L3 /w notepad
```

in a Windows DOS box returns the listing shown in Figure 1. In this rather extensive list you'll notice that many of the DLLs are repeated. This simply means that some of the DLLs NOTEPAD loads depend on the same lower-level DLLs.

The /V (verbose) switch goes even further by telling FINDEXEC to continue searching until it has listed every file required by every DLL. Especially under OS/2, using the /V switch can result in hundreds of lines of library listings. In most cases, checking one or two levels is enough, but if you want the complete run-down for all libraries, the /V switch will provide it.

FINDEXEC's final switch parameter, /?, brings up a help screen that explains the program's full syntax.

FINDING A PROGRAM As indicated earlier, depending on the operating system in use, FINDEXEC employs the same search methods used by DOS, Windows, or OS/2 to find an executable file. Since

Sample FINDEXEC Output

```
Windows Program: C:\WINDOWS\notepad.exe
Loads:
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\GDI.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\USER.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\GDI.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\SYSTEM.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\KEYBOARD.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\MOUSE.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\SYSTEM.DRV
Windows DLL: DISPLAY
Windows DLL: C:\WINDOWS\SYSTEM\SOUND.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\COMM.DRV
Windows DLL: C:\WINDOWS\SYSTEM\SYSTEM.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\KEYBOARD.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\COMMDLG.DLL
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\GDI.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\USER.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\GDI.EXE
Windows DLL: C:\WINDOWS\SYSTEM\SYSTEM.DRV
Windows DLL: C:\WINDOWS\SYSTEM\KEYBOARD.DRV
Windows DLL: C:\WINDOWS\SYSTEM\MOUSE.DRV
Windows DLL: DISPLAY
Windows DLL: C:\WINDOWS\SYSTEM\SOUND.DRV
Windows DLL: C:\WINDOWS\SYSTEM\COMM.DRV
Windows DLL: C:\WINDOWS\SYSTEM\KEYBOARD.DRV
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\SHELL.DLL
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\GDI.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\USER.EXE
Windows DLL: KERNEL
Windows DLL: C:\WINDOWS\SYSTEM\GDI.EXE
Windows DLL: C:\WINDOWS\SYSTEM\SYSTEM.DRV
Windows DLL: C:\WINDOWS\SYSTEM\KEYBOARD.DRV
Windows DLL: C:\WINDOWS\SYSTEM\MOUSE.DRV
Windows DLL: DISPLAY
Windows DLL: C:\WINDOWS\SYSTEM\SOUND.DRV
Windows DLL: C:\WINDOWS\SYSTEM\COMM
```

Figure 1: The FINDEXEC /Ln switch sets the number of levels of DLL information that are reported. To get this output, the switch was set to /L3 on the author's machine.

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these search methods differ somewhat, however, it may be useful to discuss them in detail.

The search for DOS executable files is actually performed by COMMAND.COM. If the user enters a path along with the desired program name, COMMAND.COM looks no further than the specified directory for the file. If no extension is specified, COMMAND.COM looks first for a .COM file, then for an .EXE file, and finally for a .BAT file that matches the filename. Under DOS versions earlier than 4.0, even a user-specified file extension is ignored and the .COM-.EXE-.BAT search order is imposed. When a matching file is found, COMMAND.COM uses DOS's

Exec function (Int 21 function 4Bh) to execute the file.

If the user does not enter a path along with the program name, COMMAND.COM starts by looking for the file in the current directory. Here again, if the user does not specify an extension (or even if he does, under DOS versions prior to 4.0), DOS follows the .COM-.EXE-.BAT order in looking for the file. If no matching file is found, COMMAND.COM then searches for it successively in each of the directories listed in the PATH environment variable. The .COM-.EXE-.BAT sequence is followed within each directory, but a batch file with a .BAT extension will be executed instead of a program with a

.COM extension if the .BAT file is in a directory listed earlier in the PATH.

The DOS APPEND program can modify the program search order. If APPEND is loaded with the /X:ON switch specified, COMMAND.COM looks in the APPENDED directories before it turns its attention to any path directories. Indeed, if both the /PATH:ON and /X:ON switches are set on APPEND, COMMAND.COM will load a program from the APPENDED directories even if the user specifies a path along with the program name. Thus, the effect of APPEND is to make COMMAND.COM (and any other DOS program) think that all the files in the APPENDED directories are located in the current directory. Since

the current directory is checked before PATH directories, files in the APPENDED directories are executed before programs in the path.

The Windows search method is more complex. It is used by Windows when a program is launched from the File | Run menu item in the Program Manager or when a path is not included for an icon in the Program Manager window. Actually, the Program Manager doesn't perform the search for the program; Windows does. Windows uses its search method for any program (including the Program Manager) that uses WinExec, the Windows API function, to launch a program.

Thus, there is a fundamental difference between DOS and Windows file searches. In DOS, it is COMMAND.COM that determines the order of the search. In Windows, it is the Win-

Exec API call that determines the search order. Any program that uses WinExec, such as my own WinCmd interpreter (which appeared in the April 27, 1993, Utilities column), automatically ends up using the Windows search method. The equivalent DOS API—that is, Exec (Int 21 Function 4Bh)—performs no searches. The Exec function works only if the program specified is in the current directory or if a path is specified along with the program name.

As with a DOS search, a Windows search depends on whether a path is specified with the filename. If so, then the search for the file is restricted to the directory specified. If a filename is entered by itself, Windows starts its search with the working directory, just as in DOS. DOS users know the *working* directory as the *current* directory.

If the program name sent to WinExec

includes an extension, Windows looks only for a file that matches the name and extension. If an extension is not specified, however, Windows does not restrict itself to the familiar .COM, .EXE, and .BAT DOS extensions. Instead, Windows looks for files with extensions that are listed in the Programs= item in the [Windows] section of WIN.INI. By default, these extensions are .COM, .EXE, .BAT, and .PIF, but other extensions can be added. For example, an .SCR extension is often added to the Programs= list so that Windows will look for screen savers. Windows uses the extensions in the order they are listed in Programs=. The default order looks like the DOS extension order with the .PIF extension added. In Windows, PIF (program information file) files are used to customize a DOS program's execution.

After looking for the file in the current

FINDEXEC.C

Partial Listing

```
// GetEXEType - Loads a file and returns its operating system.
//-----
INT GetEXEType (char *szFileName, INT *psNumRefEnt, LONG *plFPtr) {
    PBYTE lpbData;
    USHORT usSel, usBytesRead;
    INT sTargOS;
    HFILE hFile;

    if (DosAllocSeg (BUFFSIZE, &usSel, 0))
        return ERR_OUTOFMEM;
    lpbData = MAKEP (usSel, 0);

    hFile = FileOpen (szFileName);
    if (hFile == -1) {
        DosFreeSeg (usSel);
        return ERR_NOOPENEXE;
    }
    DosRead (hFile, lpbData, BUFFSIZE, &usBytesRead);
    if (usBytesRead < 0x40) {
        FileClose (hFile);
        DosFreeSeg (usSel);
        return 0;
    }
    //Check for the old EXE header signature "MZ"
    if (*(PUSHORT)lpbData != 0x5a4d) {
        FileClose (hFile);
        DosFreeSeg (usSel);
        return 0;
    }
    //Check for New EXE header
    if (*(PUSHORT)lpbData < 0x40) {
        FileClose (hFile);
        DosFreeSeg (usSel);
        return 0;
    }
    //Read New EXE header
    *plFPtr = (LONG) *((PULONG)lpbData+0x3C);
    DosChgFilePtr (hFile, (LONG) *plFPtr, 0, plFPtr);

    DosRead (hFile, lpbData, BUFFSIZE, &usBytesRead);
    FileClose (hFile);

    switch (*(PUSHORT)lpbData) {
        case 0x454E: //Check for NewEXE (NE)
            if (*(PUSHORT)lpbData & 2)
                sTargOS = 1; //Windows
            else if (*(PUSHORT)lpbData & 1)
                sTargOS = 2; //OS/2 1.x

            if (*(PUSHORT)lpbData+0x8C & 0x0000)
                sTargOS += 0x100; //Library

            if (psNumRefEnt != 0)
                *psNumRefEnt = *(PUSHORT)lpbData+0x1E;
            if (plFPtr != 0)
                *plFPtr += (LONG) *((PULONG)lpbData+0x28);
            break;

        case 0x454C: //Check for LinearEXE (LE)
            sTargOS = 3; //Win 3.x Enh mode
            if (*(PULONG)lpbData+0x10 & 0x0000)
                sTargOS += 0x100; //Library

            if (psNumRefEnt != 0)
                *psNumRefEnt = (INT) *((PULONG)lpbData+0x74);
            if (plFPtr != 0)
                *plFPtr += (LONG) *((PULONG)lpbData+0x70);
            break;

        case 0x584C: //Check for LinearEXE (LX)
            sTargOS = 4; //OS/2 2.x
            if (*(PULONG)lpbData+0x10 & 0x0000)
                sTargOS += 0x100; //Library

            if (psNumRefEnt != 0)
                *psNumRefEnt = (INT) *((PULONG)lpbData+0x74);
            if (plFPtr != 0)
                *plFPtr += (LONG) *((PULONG)lpbData+0x70);
            break;

        case 0x455B: //Check for LinearEXE (PE)
            sTargOS = 5; //Win/NT
            if (psNumRefEnt != 0)
                *psNumRefEnt = 0;
            break;
    }
    DosFreeSeg (usSel);
    return sTargOS;
}
```

Figure 2: The GetEXEType routine in FINDEXEC is used to determine the target operating system of an executable.

directory, Windows turns to the Windows directory. The Windows directory is where files such as WIN.COM, WIN.INI, and SYSTEM.INI are stored. Next, Windows looks in its system directory. This is the directory that holds such files as GDI.EXE and USER.EXE, along with the driver files that Windows uses.

If the file has still not been found, Windows looks next in the directory that holds the program calling WinExec. This directory may be different from the current or working directory. For example, if the calling program is launched from C:\DATA, but the Windows program itself is located in the C:\PROGRAMS directory, the *current* directory is C:\DATA, but the directory containing the executable file for the current task is C:\PROGRAMS. After checking the calling program's directory, Windows looks successively in each of the directories that are listed in the PATH. If the program is not found there, Windows examines any network directories that have been mapped.

When a Windows program requires a DLL, Windows checks to see whether another program has already loaded the same DLL. If so, Windows simply directs any calls to the DLL to the already-loaded copy. If the DLL is not in memory, Windows looks for it in the same directories that were scanned in the original program search. The only difference is that in this search Windows looks only for files with a .DLL extension. (Windows driver files with a .DRV extension are also DLLs, but they will already have been loaded at the time Windows was started.)

OS/2's method for searching for programs is closer to that of DOS than to that of Windows. The search is performed by CMD.EXE, which is OS/2's version of DOS's COMMAND.COM. If no path is specified with the program name, CMD.EXE looks in the current directory, then in each one of the directories listed on the PATH. CMD.EXE looks for the files with the extensions .COM, .EXE, .CMD, and .BAT, in that order. (CMD files are OS/2's equivalent of DOS batch files.)

As with DOS 4.0 and later, and as with Windows, the user can restrict the search

File, Memory, and Operating System Functions

1 of 2

Function	Description
DosAllocHuge	Allocates huge memory block greater than 64KB
DosAllocSeg	Allocates memory block
DosBeep	Generates tone
DosBufReset	Flushes file buffers, updates directory
DosCaseMap	Translates ASCII string in place
DosChDir	Selects current directory
DosChgFilePtr	Sets file pointer position
DosCLIAccess	Notifies intent to use CLI and STI
DosClose	Closes file, pipe, or device
DosCreateCSAlias	Obtains executable alias for data segment
DosDelete	Deletes file
DosDevConfig	Returns system hardware configuration
DosDevIOCtl	Device-specific commands and information
DosDupHandle	Duplicates or redirects handle
DosErrClass	Returns information about error code
DosError	Disables or enables system critical error handler
DosExecPgm	Creates child process
DosExit	Terminates thread or process
DosFileLocks	Locks or unlocks file region
DosFindClose	Releases directory search handle
DosFindFirst	Searches for first matching file
DosFindNext	Searches for additional matching files
DosFreeSeg	Releases selector
DosGetCollate	Returns collating sequence table
DosGetCp	Returns current code page identifier
DosGetCtryInfo	Returns internationalization information
DosGetDateTime	Returns current time, date, and day of week
DosGetDBCSEv	Returns table of double-byte character-set codes
DosGetEnv	Returns selector for process's environment
DosGetHugeShift	Returns increment value for huge memory block selectors
DosGetMachineMode	Returns flag indicating real or protected mode
DosGetMessage	Retrieves message from disk file
DosGetVersion	Returns DOS or OS/2 version number
DosHoldSignal	Suspends signal processing for current process
DosInsMessage	Inserts variable text into body of message
DosMkDir	Creates directory
DosMove	Renames and/or moves file
DosNewSize	Changes size of file
DosOpen	Opens, replaces, or creates file, or opens device
DosPortAccess	Notifies intent to use range of I/O ports
DosPutMessage	Sends message to file, pipe, or device
DosQCurDir	Returns current directory
DosQCurDir	Returns current directory
DosQCurDisk	Returns current disk drive
DosQFHState	Returns file handle sharing and access characteristics
DosQFileInfo	Returns file size, attributes, and date and time stamps
DosQFileMode	Returns file attributes
DosQFSInfo	Returns file system information or volume label
DosQVerify	Returns state of read-after-write flag
DosRead	Reads data from file, pipe, or device
DosReallocHuge	Resizes huge memory block
DosReallocSeg	Resizes normal memory block
DosRmDir	Deletes directory
DosOpen	Opens, replaces, or creates file, or opens device
DosPortAccess	Notifies intent to use range of I/O ports
DosPutMessage	Sends message to file, pipe, or device

Figure 3: Here is a list of the OS/2 Family Application functions.

File, Memory, and Operating System Functions

2 of 2

Function	Description
DosQCurDir	Returns current directory
DosQCurDisk	Returns current disk drive
DosQFHState	Returns file handle sharing and access characteristics
DosQFileInfo	Returns file size, attributes, and date and time stamps
DosQFileMode	Returns file attributes
DosQFSInfo	Returns file system information or volume label
DosQVerify	Returns state of read-after-write flag
DosRead	Reads data from file, pipe, or device
DosReallocHuge	Resizes huge memory block
DosReallocSeg	Resizes normal memory block
DosRmdir	Deletes directory
DosSelectDisk	Selects current disk drive
DosSetDateTime	Sets current date and time
DosSetFHState	Sets file handle characteristics
DosSetFileInfo	Sets file time and date stamps
DosSetFileMode	Sets file attributes
DosSetFSInfo	Adds or changes volume label
DosSetSigHandler	Registers signal handler
DosSetVec	Registers handler for hardware exception
DosSetVerify	Sets system read-after-write flag
DosSleep	Suspends requesting thread for specified interval
DosSubAlloc	Allocates memory from local heap
DosSubFree	Releases memory in local heap
DosSubSet	Initializes local heap
DosWrite	Writes to file, pipe, or device
Keyboard functions	
KbdCharIn	Returns keyboard character and scan code
KbdFlushBuffer	Discards waiting keyboard characters
KbdGetStatus	Returns logical keyboard status
KbdPeek	Returns character-waiting status
KbdSetStatus	Sets logical keyboard characteristics
KbdStringIn	Reads buffered line from keyboard
Video functions	
VioGetBuf	Returns address of logical video buffer
VioGetConfig	Returns hardware characteristics of video adapter
VioGetCurPos	Returns cursor position
VioGetCurType	Returns cursor shape, size, and attribute
VioGetMode	Returns characteristics of current display mode
VioGetPhysBuf	Returns selector for physical video display buffer
VioReadCellStr	Reads string of character-attribute pairs
VioReadCharStr	Retrieves character string from display buffer
VioScrLock	Locks physical display for I/O
VioScrollDn	Scrolls display down
VioScrollLf	Scrolls display left
VioScrollRt	Scrolls display right
VioScrollUp	Scrolls display up
VioScrUnLock	Releases lock on physical display
VioSetCurPos	Sets cursor position
VioSetCurType	Sets cursor shape, size, and attribute
VioSetMode	Selects display mode
VioShowBuf	Updates physical display from logical display buffer
VioWrtCellStr	Writes character-attribute pairs to display
VioWrtCharStr	Writes character string to display
VioWrtCharStrAtt	Writes character string with specified attribute to display
VioWrtNAttr	Changes attributes of one or more characters on display
VioWrtNCell	Writes one or more character-attribute pairs
VioWrtNChar	Writes one or more characters
VioWrtTTY	Writes character string to display in teletype mode

by specifying the program's extension. Thus, if the user asks for PROG.EXE, CMD.EXE will ignore a program called PROG.COM even if the latter is in the same directory. OS/2 is intelligent enough to launch a Presentation Manager or DOS application from the OS/2 command line if the program found is a PM or DOS application. By contrast, attempting to execute a Windows program from a Windows DOS box results in the silly message, "This program requires Microsoft Windows."

Like Windows programs, OS/2 programs frequently require DLLs in order to run. When trying to locate a DLL, OS/2 looks first in the directories specified in the LIBPATH parameter of CONFIG.SYS. If the DLL is not found in one of the LIBPATH directories, the directory containing the program is searched. Unlike the program search, the search for DLLs is performed by the OS/2 system, not by CMD.EXE. That's because DLLs are used by all OS/2 programs, not just by those launched by CMD.EXE.

FINDEXEC SEARCHES Simply put, FINDEXEC itself uses the same rules to hunt for programs as do DOS, Windows, and OS/2. For DOS and OS/2, FINDEXEC looks in the current directory, then checks each directory listed in the PATH statement. The Windows search is a bit more complex, since the Windows and Windows system directories must be checked. FINDEXEC performs all these searches by brute force, using the Dos-FindFirst API function to locate the first file with a proper extension.

FINDEXEC's real work comes after an OS/2 or Windows executable file is found during a Windows or OS/2 search. In these cases, FINDEXEC must determine whether the program requires any DLLs and, if so, it must then locate those DLLs. And to know what DLLs a program needs, FINDEXEC must know a little about the format of the executable file.

The structure of Windows .EXE and OS/2 1.x .EXE files is quite similar; both use the New Executable (NE) .EXE format. NE format programs are actually two programs bundled into one. The file begins with a standard (old) DOS .EXE header and a small DOS stub program.

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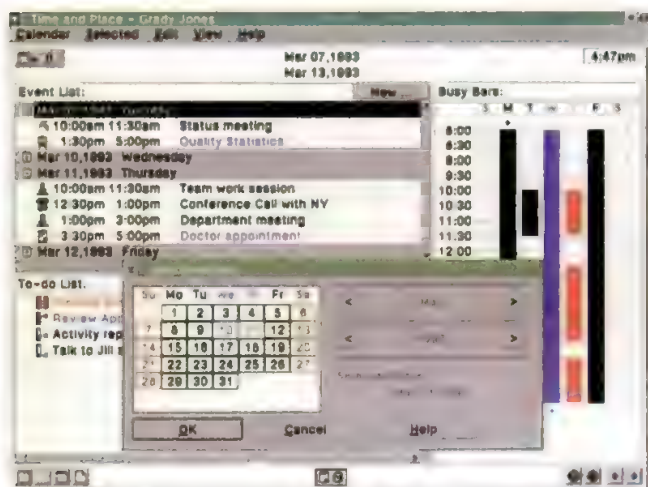
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When run under DOS, the DOS Exec function sees the DOS .EXE header and loads the small DOS stub. Normally, the stub program simply prints out a message, such as "This program requires OS/2," or "This program requires Microsoft Windows." However, a pointer in the old .EXE header contains the offset in the file of the real .EXE header for the program. Both OS/2 and Windows look for this new header, which they use in loading the program.

The NE header is much more complex than the old, standard DOS header. The NE header begins with a signature word—the ASCII characters NE—that serves to identify it. The header itself contains pointers and offsets to various tables for resources, entry points into the program, and—what FINDEXEC is interested in—the list of the program's required DLLs. The NE header is documented both in the Windows Software Development Kit and in Appendix D of Ray Duncan's *Advanced OS/2 Programming* (Microsoft Press, 1991).

Enhanced-mode Windows applications, OS/2 2.x applications, and Windows/NT applications use different and mutually incompatible .EXE file formats. All that these formats have in common are the real-mode DOS stub program idea and a format-identifying signature in the first 2 or 4 bytes at the start of their new .EXE headers.

The alphabet soup of .EXE formats includes the LX format for OS/2 2.x programs, the LE format for Windows VxD drivers, and the PE format for Windows/NT programs. A detailed explanation of these formats is beyond the scope of this article, but Ray Duncan has discussed each of them (in the February 9, March 16, and March 30, 1993, Power Programming columns).

For each supported .EXE type, FINDEXEC determines the type of .EXE and then reads in the list of required DLLs. The code for determining the .EXE type is shown in Figure 2. Briefly summarized, the GetEXEType routine opens the file and reads in the DOS .EXE header. If the value at offset 18 hex is greater than 40 hex, the file contains one of the new header types. A pointer to the new header is located at offset 3C hex in the old header. GetEXEType reads in the

QUICK REFERENCE GUIDE

FINDEXEC.EXE

Command



Douglas Boling

August, 1993 (Utilities)

Purpose:

Searches all drives/directories on the system PATH and reports the location of the executable file that will run when entered at a DOS, OS/2, or Windows command prompt. Under Windows or OS/2, also reports the requisite dynamic link libraries (DLLs) and, optionally, the DLLs required by those DLLs and so on.

Format:

FINDEXEC [/W] [/V | /Ln] [/?] *program_name*

Remarks:

In locating *program_name*, FINDEXEC uses the DOS search method under DOS and the OS/2 search method under OS/2. By default, a DOS-style search method is used from a Windows DOS Box prompt. The /W switch causes the Windows search order to be followed if and only if Windows is loaded.

Under Windows and OS/2, FINDEXEC also returns the names and locations of all DLLs needed by *program_name*. Since these DLLs may require DLLs of their own in order to run properly, the /Ln switch can be used to extend the DLL search to the level designated by *n*. Alternately, an exhaustive DLL search can be specified by using the /V (Verbose) switch.

Note:

Certain DLLs, such as KERNEL.DLL and DISPLAY.DLL (in Windows 3.1) or DOSCALLS.DLL (OS/2), are not actually files, but are simply created in memory at the time the operating system is loaded. For this reason, FINDEXEC cannot report the path to them.

The /? switch returns the full syntax for FINDEXEC, together with a brief explanation of each switch.

The executable and C-source files for FINDEXEC can be downloaded from PC MagNet under the filename FINDEX.ZIP. FINDEXEC.EXE is technically a specialized OS/2 1.x program designed to run under DOS, OS/2, and Windows. To recreate it from the source code requires a compiler that supports OS/2 1.x and the BIND.EXE program that was that was supplied in the OS/2 1.x Software Development Kit.

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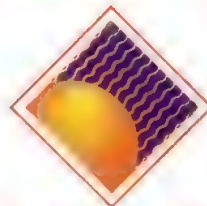
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header and then uses the signature bytes at the start of the new header to determine the .EXE type.

A FAPI APPLICATION How can one program be both a DOS application and an OS/2 application at the same time? If you browse through the FINDEXEC source code, you'll find that there are a number of calls to the OS/2 API but none to DOS. In fact, FINDEXEC is an OS/2 1.x program that uses a subset of the OS/2 1.x character-mode API. So, how can FINDEXEC run under DOS when it is an OS/2 program?

The answer is that FINDEXEC is compiled, linked, and bound into what is called a *Family Application*. A Family Application uses a limited part of the OS/2 API that can be translated into DOS calls by means of a special binding layer when the program is run under DOS.

With all the conflicts over PC operating systems these days, I find it amazing that the character-mode OS/2 1.x API is supported by all the new operating systems. You'd expect that IBM's OS/2 2.x would be backward-compatible with OS/2 1.x, but even Microsoft's Windows/NT supports OS/2 1.x character-mode applications. Add the ability of a Family Application to run under DOS, and you end up with an application that will execute under every mainstream operating system running on the PC today!

The set of Family API (FAPI) functions is listed in Figure 3. To an OS/2 programmer the list will look rather sparse, but a DOS programmer will find a veritable feast of powerful functions. The only glaring omission is a set of mouse functions. To handle a mouse, FAPI programs must use MOUSE.COM's Int 33 calls when run under DOS and OS/2 MouXXX calls when run under OS/2 or Windows NT.

Family Applications must be written as OS/2 apps, with none of the straight-to-the-hardware practices normally found in DOS programs. Further, since a FAPI program executes in protected mode under OS/2, strict segment discipline must be maintained. That means no accessing of unallocated memory locations and no segment arithmetic beyond what is allowed when dealing with huge pointers. Unfortunately, when executing

under DOS, FAPI applications are subject to the DOS real-mode limit of 640K of total RAM.

Though FAPI applications are supported by the current operating systems, actually creating one is an exercise in technological archeology. The problem is that neither OS/2 1.x nor the FAPI concept ever really caught on. To compile a FAPI application, you need both a compiler that supports OS/2 1.x and the BIND.EXE program that was bundled with the OS/2 1.x Software Development Kit. Microsoft's C 5.1 and 6.0 compilers represent another source for the OS/2 1.x

***One Family Application
utility can replace
three utilities and ensure
that you won't have
the wrong utility when
you boot up a different
operating system.***

libraries and for BIND. Unfortunately, Microsoft removed OS/2 support and BIND.EXE from its C 7.0 product, so if you upgraded and deleted all the old compiler files, you're out of luck. IBM is not much help either; the OS/2 2.0 Software Development Kit can't be used to create OS/2 1.x applications. And although IBM has kept the OS/2 1.x SDK in its product list, it may be a chore actually getting hold of such an old product. My advice is to hunt through your old compiler files or give your compiler vendor a call.

FAPI applications are compiled as OS/2 character-mode applications. The compiler and linker must support OS/2 1.x. The OS/2 resource compiler is also necessary to set the appropriate flags in the EXE header. Finally, the BIND program is necessary to turn the OS/2 application into a FAPI application.

BIND.EXE is the key to the FAPI concept. When BIND is run against an OS/2 1.x character-mode application, it replaces the standard DOS stub program

with a set of libraries that translate the OS/2 API calls into DOS calls. For example, if a FAPI program called the OS/2 function DosFindFirst, BIND would hook in a routine that would translate the DosFindFirst call into DOS's Find First call (Int 21h Function 4Eh). On the other hand, when the FAPI program is executed in protected mode, the DOS API translation program that BIND hooked in is skipped in favor of the native protected-mode code.

Once the real-mode routines have been hooked into an OS/2 application, that application will run under DOS and OS/2 without requiring any special files. In fact, without looking at the structure of the .EXE file itself, you won't be able to tell a FAPI application from a DOS or OS/2 character-mode application.

If the FAPI concept is so attractive, why isn't every DOS application a FAPI application? The answer lies in the commercial fate of OS/2 1.x. Faced with a lack of user enthusiasm for OS/2, the software industry saw no need to write applications that were compatible with both DOS and with the tiny OS/2 1.x market. When IBM then released OS/2 2.0, with its excellent DOS emulation, FAPI was again deemed unnecessary, for now OS/2 could run almost every DOS application automatically.

Despite industry indifference, however, there is still a place for FAPI. It's the perfect format for utility programs such as FINDEXEC. Utilities tend to be simple, but they must find a place under DOS, OS/2, and, in the future, Windows/NT. One FAPI utility can take the place of DOS, OS/2, and Windows utilities and ensure that you won't have the wrong utility when you boot up a different operating system. FAPI utilities are also needed on OS/2 systems whose DOS emulation has been disabled with the PROTECTONLY switch.

FINDEXEC is a handy utility that works in all kinds of environments. Its services are useful on the smallest 256K PC as well as on the biggest server running OS/2. So stop guessing exactly what program actually ran and where it is; let FINDEXEC tell you. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR TO PC MAGAZINE.

An Introduction to Multithreading Under Windows NT

BY CHARLES PETZOLD

A particular feature of an operating system does not exist because it appeals to ivory tower academics, or because it provides a challenge for the developers to implement, or because someone thought it was a neat idea.

No, operating system features exist to solve problems, and this is certainly true of multithreading. At first it may seem as if multithreading was invented because someone thought it would be fun to have different parts of the same program running concurrently. But multithreading solves some programming problems with an efficiency that is just not otherwise possible.

That's what I'll try to demonstrate in this column as we begin our exploration of multithreading under Windows NT. NT is Microsoft's new 32-bit operating system. It is not yet released at the time I'm writing this (early May), but it probably will be by the time you read this. I'm using the March beta release, which still has some problems (as we'll see in a moment).

LET'S START SIMPLE Because this is the first foray of the Environments column into NT programming, I'm going to begin with a very short and simple character-mode program that runs from the NT command line prompt. The design goal for this program is to beep approximately every second and to be terminated by a keystroke.

Despite its simple aspirations, I think this program clearly illustrates how multithreading can solve some programming problems in a very straightforward manner. Without the overhead of a normal Windows program, a character-mode program can better demonstrate the bare necessities required to create a multithreaded program.

I'm starting with a character-mode program for another reason, too. I've heard several people say that NT forces you to write Windows programs, and indeed, some people believe that Microsoft is trying to eliminate character-mode programming entirely.

This is just not true. In fact, one of the many enhancements to Windows NT, which is not in the DOS-based version of Windows, is the inclusion of a set of 41 function calls designed specifically for

*A simple, character-based
beeping program
demonstrates how NT's
multithreading capability
can efficiently solve
programming problems.*

writing character-mode programs that run in a text window under NT. These are called *console* functions, and programs that use them are called console applications. Just as in the DOS-based Windows, you can switch a console application between a text-mode window and full screen by pressing Alt-Enter.

If anything is forcing programmers to write graphical programs, it's the market. But if you want to ignore the market and write character-mode applications instead, the Windows NT console functions give you everything you need to write a normal character-mode program, including cursor positioning, scrolling, and reading keyboard and mouse events.

While I'm not going to make use of this console support explicitly in these little programs, I will use some C runtime

library functions (defined in CONIO.H) that employ the NT console functions. Specifically, these are the `_kbhit()` function, which allows you to detect whether a key has been pressed, and the `_getch()` function, which reads a keystroke. (The function names are preceded by underscores because they are not part of the ANSI C standard. However, they are commonly included in many C runtime libraries.)

THE INEFFICIENT VERSION The goal here is to write a program that beeps approximately once every second and is terminated by a keystroke. Under DOS, such a program might look like the BEEP1 program shown in Figure 1. (Indeed, you can compile this program for DOS and it will run without any problems.) Figure 2 shows the make file for compiling the program for Windows NT from an NT command line.

If you have the Windows NT Software Development Kit (SDK) installed, you can type the code in Figures 1 and 2 into ASCII text files and compile and link the program by running

```
NMAKE BEEP1.MAK
```

on an NT command line. Or, you can download the source code and executable files for BEEP1 and the other programs mentioned here from PC MagNet's Programming Forum, archived as BEEP.ZIP.

The program begins by calling the `Ctime()` function to obtain the current system time in seconds. It then enters a while loop, checking each time to see if a key has been struck. The program beeps by using `putchar()` to write a '\a' character to standard output. The *a* stands for *alarm* and translates to a Ctrl-G, which causes a beep to sound. The program then enters another while loop, continu-

BEEP1.C

Complete Listing

```

/*-----
BEEP1.C -- NT Beeper Program #1
(c) Charles Petzold, 1993
-----*/

#include <stdio.h>
#include <conio.h>
#include <time.h>

int main (void)
{
    time_t lTime1, lTime2 ;

    time (& lTime2) ;

    while (! _kbhit ())
    {
        lTime1 = lTime2 ;

        putchar ('\a') ;

        while (! _kbhit () && lTime1 == lTime2)
        {
            time (& lTime2) ;
        }
    }

    _getch () ;

    return 0 ;
}

```



Figure 1: BEEP1.C is the inefficient source code for the beeper program.

ously calling the time() function (to check if the time has changed, indicating that a second has elapsed) and the _kbhit() function (to check if a key has been struck).

When a key is struck, the program drops out of both while loops and reads the struck character by calling _getch(). The program then terminates.

Unfortunately if you're using the March beta release of Windows NT, the program will not work correctly—mainly because the _kbhit() function always returns a -1 regardless of whether a key has been struck or not. To get the program working under the March release, comment out the ! symbols in the while statements and terminate the program by pressing Ctrl-C.

What is wrong with the BEEP1 program? Nothing really, if it's the only thing running on the system. But in a multitasking environment, BEEP1 is a real pig. BEEP1 runs continuously, always eating up CPU cycles and spending most of its time calling the time() and _kbhit() functions.

Indeed if you run WINPERF, the Windows performance utility supplied with the Windows NT SDK, you'll find

haven't encountered any NT make files, you may have blinked a few times when looking at BEEP1.MAK. All the sample code included with the SDK uses make files that look something like this one, with compile and link command lines consisting mostly of several identifiers enclosed in parentheses and preceded by dollar signs.

These identifiers are make-file macros. The macros may be defined in the make file itself, as environment variables, or in another included file. In the case of BEEP1.MAK, the macros are defined in NTWIN32.MAK, which is included toward the beginning of the make file. NTWIN32.MAK comes with the Windows NT SDK.

When you compile a program using such a make file on an Intel 386 or 486 machine (which most of us now use), NTWIN32.MAK defines these identifiers as appropriate for 32-bit Intel-based machines. When you compile on a MIPS RISC box, the

that this little program consumes about 80 percent of total CPU time.

To make this program more efficient under DOS, you'd probably resort to hooking in to the hardware keyboard and timer tick interrupts. This is something that I hope provokes the reaction of "Yuck!" One of the reasons many of us welcome the advent of more advanced operating systems such as Windows and Windows NT is that we can write efficient programs without the kludges and instabilities of TSRs and without intercepting hardware interrupts.

WHAT'S THAT MAKE FILE? Before I continue, I want to draw your attention to Figure 2. If you

identifiers are defined differently to use a different compiler, compiler flags, and so forth.

NTWIN32.MAK can define these variables differently because it uses environment variables (set during NT startup) that identify the processor. The use of NTWIN32.MAK allows you to use the same make file for developing a program that runs under both platforms.

Here's how these identifiers are defined for Intel 386/486 executables:

In the compile step, the cc identifier is the compiler program name, defined as cl386—Microsoft's 32-bit NT C compiler. The cflags identifier defines compiler flags, specifically -c -W3 -G3, which are flags to compile without linking, display level 3 warning messages, and compile with 32-bit code. The cvars identifier is defined as D_X86_1 DWIN32. This defines two variables that you can use for conditional compilation—for example, for when you need to use some different code for the RISC version of your program, or for the DOS-based and NT-based versions of Windows.

In the linking step, the link variable is defined as link32, the name of the NT linker. The conflags variable is

```

-subsystem:console -entry:
mainCRTStartup

```

These identify the program as a console program and indicate the program starting point. The conlibs variable is defined as

```

libc.lib kernel32.lib ntdll.lib

```

which are the libraries to link with the program in order to create the executable. LIBC.LIB is the C runtime library,

BEEP1.MAK

Complete Listing

```

#-----
# BEEP1.MAK make file
#-----

!include <ntwin32.mak>

beep1.exe : beep1.obj
$(link) $(conflags) -out:beep1.exe beep1.obj $(conlibs)

beep1.obj : beep1.c
$(cc) $(cflags) $(cvars) beep1.c

```



Figure 2: This make file compiles and links BEEP1.C to create BEEP1.EXE.

BEEP2.C

Complete Listing

```

/*-----
BEEP2.C -- NT Beeper Program #2
(c) Charles Petzold, 1993
-----*/

#include <windows.h>
#include <stdio.h>
#include <conio.h>

int main (void)
{
    while (! _kbhit ())
    {
        putchar ('\a') ;

        Sleep (1000) ;
    }
    _getch () ;

    return 0 ;
}

```



Figure 3: This version uses the Sleep() function for better efficiency.

and KERNEL32.LIB and NTDLL.LIB are import libraries.

If you were creating a graphical Windows NT program, you'd use the identifiers `guiflags` and `guilibs` rather than `conflags` and `conlibs`. Also—as we'll see later in this column—you use some different identifiers when creating a multithreaded program.

THE BENEFITS OF SLEEP Although we're eventually going to make a multithreaded version of the BEEP program, Windows NT has another handy little solution to the inefficiency of the BEEP1 version. This is the Sleep() function.

Let's review a little how multitasking works: At any time, there may be multiple threads of execution running under the system. (A thread is a series of sequential machine code instructions that are associated with a unique CPU register state and stack.) The operating system periodically receives a hardware timer interrupt. Under Windows NT, the timer interrupt is programmed to occur every 15 milliseconds. When the system receives a timer interrupt, it is then free to switch execution from one thread to another; this procedure is known as time slicing.

Every thread of execution has a certain priority which governs how NT divides the time slices among the threads. Threads can also be suspended for various reasons, such as waiting on keyboard

input or waiting on a semaphore. A thread can suspend itself voluntarily by "going to sleep." This is accomplished by calling the following function:

```
Sleep (dwTimeout) ;
```

The single parameter is a time in milliseconds. The function call does not return until the specified time has elapsed. During that time, the thread is suspended and is allocated no time slices (although obviously the thread still requires a small amount of processing time during timer ticks when the system must determine if the thread should be resumed).

A parameter of 0 to the Sleep() function causes the thread to forfeit the remainder of its time slice. The system can then allocate the rest of that time slice to another thread.

Figures 3 and 4 show the BEEP2 program that uses the Sleep() function. As you can see, the Sleep() function is ideal for this program. Not only is BEEP2 much more efficient than BEEP1, but it's also shorter, requiring no calls at all to the C `time()` function, and only one call per second to `_kbhit()`. The WINPERF utility shows BEEP2 using only 2 percent of CPU time. Notice that BEEP2.C includes `WINDOWS.H`, even though it is not a graphical Windows program. `WINDOWS.H` is necessary for the definition of the Sleep() function.

BEEP2 introduces a problem we didn't have in BEEP1. Because BEEP2 calls `_kbhit()` only once every second, there could be a one-second delay between the time you press a key and the time the program terminates. That's not too bad, but if the delay were five seconds, or ten, it would be annoying.

Let's see if we can fix that problem.

THE PROBLEM AND SOLUTION BEEP1 repeatedly called two functions—`time()` and `_kbhit()`. This made the program very inefficient. We solved the problem of the `time()` function in BEEP2 by using the Sleep() function. But introducing the Sleep() function prohibited

the program from calling `_kbhit()`, except once per second. We'd prefer that the program be terminated immediately with a keystroke, but we don't want to make repeated calls to the `_kbhit()` function because that eats up processing time.

I mentioned earlier that a thread can be suspended while it is waiting for keyboard input, for instance, by calling `_getch()`. But if the thread is suspended during the `_getch()` call, then how can it continue beeping?

Well, the solution, of course, is to divide the program into two threads, one of which is suspended by calling `_getch()` until a key is pressed, and the other which is suspended—most of the time—in the Sleep() function. The BEEP3 program that uses multithreading is shown in Figures 5 and 6.

Notice also that the make file is a little different. Rather than the `cvars` variable in the compile step, you'll see `cvarsmt`. (The *mt* suffix stands for *multithread*.) This is defined the same way as `cvars` except that it also includes an additional definition: `-D_MT`. This symbol is used in some of the C header files for conditional compilation.

In the link step, `conlibs` is replaced with `conlibsm`. This replaces the `LIBC.LIB` C runtime library with `LIBCMT.LIB`, which has special multithreading versions of some of the library functions. This is necessary if two or more threads use some library functions simultaneously.

THREADS AND PROGRAM ARCHITECTURE Each thread in a C program begins with the execution of a function and generally ends with the termination of that function. That function can also call other functions in the program.

The main (or primary) thread in a C

BEEP2.MAK

Complete Listing

```

#-----
# BEEP2.MAK make file
#-----

!include <ntwin32.mak>

beep2.exe : beep2.obj
    $(link) $(conflags) -out:beep2.exe beep2.obj $(conlibs)

beep2.obj : beep2.c
    $(cc) $(cflags) $(cvars) beep2.c

```



Figure 4: BEEP2.MAK compiles and links BEEP2.C to create BEEP2.EXE.

program is, of course, the function called `main()`. A C program generally ends with the termination of `main()`, but it can also terminate at some other time by calling `exit()` or `_exit()`, either in `main` or in some other function. To create another thread in the program, you must have a function associated with that thread.

The Windows NT application programming interface (API) has a number of functions used in connection with threads, but for simple multithreaded programs like BEEP3, you don't have to use them. Instead the Windows NT C runtime library has two functions called `_beginthread()` and `_endthread()`, defined in the `PROCESS.H` header file.

The `_beginthread()` function is defined like so:

```
ulThreadID = _beginthread (Thread,
    uStackSize, pvParams);
```

The first parameter is the address of the `thread()` function, which is defined as follows:

```
void Thread (void * pvParams)
{
    ...
}
```

BEEP3.C

Complete Listing

```
/*-----
BEEP3.C -- NT Beep Program #3
(c) Charles Petzold, 1993
-----*/
```

```
#include <windows.h>
#include <process.h>
#include <stdio.h>
#include <conio.h>
```

```
void Thread (void * pParams)
{
    while (TRUE)
    {
        putchar ('\a');

        Sleep (1000);
    }
}
```

```
int main (void)
{
    _beginthread (Thread, 0, NULL);

    _getch ();

    return 0;
}
```



Figure 5: BEEP3.C is the version that uses multiple threads of execution.

For demonstration purposes, I have named this function `Thread`, but of course you may name it anything you want.

The second parameter to `_beginthread` is the size of the stack for the thread. If set to 0, the stack is set to the same size as the stack for the primary thread in the program. The third parameter is defined as a void pointer, and it is passed to the `thread()` function. This parameter is commonly used for passing initialization information to the new thread, and for sharing information among threads. The parameter can be a pointer to a large structure or a big block of data. The `_beginthread()` function returns the thread ID, which uniquely identifies the thread within the process.

After calling `_beginthread()`, the `thread()` function begins executing concurrently with other threads in the process and with other threads in the system. The thread terminates when the `thread()` function ends. A thread can also terminate itself at any other time by calling the following:

```
_endthread ();
```

This function has no parameters and returns nothing.

Even the primary thread can terminate itself by calling the `_endthread()` function, but this is not normally done; it makes more sense for the primary thread to exit in the `main()` function. At that time, cleanup code executes the C runtime `exit()` function. This function flushes all stream file buffers and closes any open files (among other things) and then terminates the process. When the process terminates, all threads in the process terminate.

Any thread can call the `exit()` or `_exit()` function to terminate the process—and all threads in the process—but again, this is not normally done. Good programming architecture mandates that only the `main()` function can terminate the process.

BEEP3.MAK

Complete Listing

```
/*-----
# BEEP3.MAK make file
#-----

!include <ntwin32.mak>

beep3.exe : beep3.obj
    $(link) $(conflg) -out:beep3.exe beep3.obj $(conlibmt)

beep3.obj : beep3.c
    $(cc) $(cflags) $(cvarmt) beep3.c
```



Figure 6: This make file compiles and links BEEP3.C to create BEEP3.EXE.

THE BEEP3 CODE With these preliminaries out of the way, the BEEP3.C code should be fairly obvious. The `thread()` function is called `Thread()` and consists of a while loop that executes “forever,” calling the `putchar()` function to beep and the `Sleep()` function to suspend the thread for one second.

The `main()` function begins by creating this thread using the `_beginthread()` function. The first parameter is the address of the `thread()` function, the second parameter is 0 to set the thread stack to the same size as the primary stack, and the third parameter is `NULL` because no information need be passed to the `thread()` function.

The `main()` function then calls `_getch()`, which normally reads the next character from the keyboard. But if a character has not been typed, `_getch()` does not return until the next keyboard character is ready. You may be nervous that some code in the `_getch()` function (or the operating system itself) continuously checks for a keystroke—but that's not the case. If a thread calls the `_getch()` function and no characters from the keyboard are available, then the thread is effectively suspended until a key is pressed.

So, the `Thread()` function is suspended most of the time in the `Sleep()` function, and the `main()` function is suspended in the `_getch()` function until you press a key. At that time, `_getch()` returns and the `main()` function terminates, which terminates the process and the secondary thread as well. BEEP3 uses approximately the same processing time as BEEP2.

In the next issue, we'll begin examining other thread-related functions supported by Windows NT. □

Integrating Windows Help: A Strategic Review

BY RAY DUNCAN

In the last several issues, I've looked at many different aspects of the Windows Help system, ranging from the help file design to the use of bitmaps and macros. While the help compiler and viewer might not be everything we wish they could be, they do make it possible for software developers to provide attractive, comprehensive, exhaustively hyperlinked on-line documentation for every Windows application.

In this installment, I want to review the integration of help support into Windows 3.x applications and provide you with a working WIN16 example program. To save time and space, I'll use a cookbook approach and will not rehash the details of each step or of the API functions involved.

BASIC HELP INTEGRATION Preparation of a skeleton help (.HLP) file for your program should come before you start modifying the application itself. Editing of the source text for the help file can be carried out either with an ASCII editor (inserting the RTF formatting codes explicitly), or in a word processor that is able to export RTF files (by far the more congenial of the two methods). You can compile the skeleton help file and debug its structure using the help compiler (HC.EXE) and the help viewer (WINHELP.EXE), and it will be extremely helpful when isolating problems later if you are confident that the help file itself and its internal hyperlinks are solid. Once you've got the skeleton working, you've reached the first implementation milestone.

The next step is to add the identifiers for the Help menu items to your application's header file, and modify the menu template in the application's resource script (.RC) file to include a Help menu

pop-up that follows the recommendations of the *Microsoft Windows Application Design Guide*. As you'll recall, the Help menu should use Alt-H as the shortcut key and should contain at least the following four items:

- Contents
- Search for Help on. . .
- How to Use Help
- About <application-name>

These four items should use the shortcut keys C, S, H, and A, respectively. Any additional Help menu items needed in

Putting it all together:

A sample program

demonstrates the

techniques you need for

integrating context-

sensitive help into your

Windows applications.

your application should be placed between the Search for Help on. . . and the How to Use Help items. Rebuild the application and confirm that the Help pop-up display appears on the menu bar and that it contains the required items in the correct order (of course, they won't do anything yet). You have now reached the second implementation milestone.

It's time to add the application code that will handle the messages generated by the Help menu pop-up. Fortunately, this code is extremely simple. Help—Contents is processed by calling the WinHelp() function with the pathname for the application help file and the command HELP_INDEX. Help—Search for

Help on. . . is handled with a similar call to WinHelp() and the command HELP_PARTIALKEY. Help—How to Use Help is processed with a call to WinHelp(), the filename WINHELP.HLP, and the command HELP_HELPONHELP. And, of course, the application responds to the Help-About menu item by allocating a thunk for the dialog callback function and calling DialogBox().

One other little piece of code is also necessary—a call to WinHelp() with the command HELP_QUIT in the routine that is responsible for processing the WM_CLOSE message. This ensures that the help viewer will not be left running when the application exits (actually this does no harm, but it breaks the user's perception of the help file as a fully controlled extension of the application). Now, rebuild the program and test each of the Help menu functions. Remember that the dialog callback must be exported in the program's module definition (.DEF) file in order to work properly. You have now reached the third implementation milestone.

The last stage in the integration of basic Help support is to arrange for the F1 key to activate the help viewer. There are three chores involved: adding an accelerator key table to the application's resource script file, loading the table at runtime with a call to LoadAccelerators() in the program's instance initialization code, and inserting a call to TranslateAccelerator() in the so-called *event loop* after the call to the GetMessage() function. When TranslateAccelerator() detects an F1 keycode message, it consumes that message and dispatches a WM_COMMAND message in its place. Again, rebuild the program and verify that pressing the F1 key has exactly the same effect as choosing the Help—Contents menu item.

CONTEXT-SENSITIVE HELP INTEGRATION

Just as with basic Help support, integrating context-sensitive help into your Windows application is a multistage process. Context-sensitive help depends on the installation of a *message hook*, which can filter all messages generated within the system related to the application. The use of hooks is a relatively esoteric Windows technology. The help file, the application's initialization code, and its message processing must all be modified, and a new callback routine must be written.

The first step is to prepare the help file by associating integer identifiers with the context strings, or labels, for the top-

ics that will need to be displayed under program control as context-sensitive help. This is accomplished by adding a [MAP] section to the help project (.HPJ) file that controls help file compilation. The context labels are listed, one per line, along with their integer IDs after the [MAP] header. For example, the following [MAP] section would associate the identifier value 1 with the topic identified by the context string menu_index:

```
[MAP]
menu_index 1
```

Now recompile the help file. Once this

is done, you're ready to turn your attention to the application source code. Begin by writing the hook callback procedure, which has a prototype of the form:

```
DWORD CALLBACK WindowsHookProc
(INT, UINT, LPVOID)
```

The parameters to the hook procedure have different meanings depending on the type of event being filtered. For message events, the first parameter indicates the application context; it can take on values such as MSGF_MENU (when a menu pop-up is active) or MSGF_DLG (when a dialog is active). The second parameter is not used. The third parameter is a far pointer to a msg[] structure containing the four familiar message components: hWnd, wParam, lParam, and lParam. Initially, I recommend that you write the hook procedure so it merely passes the event onward to the next hook procedure in the system-wide chain, via the API function CallNextHookEx().

It is also convenient at this time to change the application's initialization section so that it allocates a private message number by calling RegisterWindowMessage(). This message number should be saved in a global variable for use by the final version of the hook procedure and by the application's main message processing code. You must also add the name of the hook procedure to the EXPORTS section of the application's module definition file. At this point, rebuild the application and make sure that everything compiles and links cleanly.

Next, add the code to the application's initialization section to allocate a thunk for the hook procedure by calling MakeProcInstance(), then install the hook procedure by calling SetWindowsHookEx(). Similarly, add code to the application's terminate-and-clean-up section to release the hook by calling UnhookWindowsHookEx() and then (optionally) to release the thunk by calling FreeProcInstance(). Now rebuild the program again and run it. If everything has been coded correctly, the application will behave exactly as before—the hook will be receiving events, but since it takes no action on them, it has no net effect.

The last step is to flesh out the hook callback procedure and message handler.

DEMOAPP.H

Complete Listing

```
//
// DEMOAPP.H -- Header File for Demo Program DEMOAPP.C
//

#if !defined(WIN32)

#define WIN16 TRUE
#define WIN31

#define TCHAR char
#define TEXT(x) x

#define INT int
#define UINT WORD
#define APIENTRY PASCAL
#define WNDPROC FARPROC

#else

#define WIN16 FALSE

#endif

struct decodeUINT { // structure associates
    UINT Code; // messages or menu IDs
    LONG (*Fxn)(HWND, UINT, UINT, LONG); // with a function

#define IDM_EXIT 100
#define IDM_HELPCONTENTS 101
#define IDM_HELPSEARCH 102
#define IDM_HELPONHELP 103
#define IDM_HELPABOUT 104

// Function prototypes
INT APIENTRY WinMain(HANDLE, HANDLE, LPSTR, INT);
BOOL InitApp(HANDLE);
BOOL InitInstance(HANDLE, INT);
BOOL TermInstance(HANDLE);
LONG CALLBACK FrameWndProc(HWND, UINT, UINT, LONG);
BOOL CALLBACK AboutDlgProc(HWND, UINT, UINT, LONG);
DWORD CALLBACK WindowsHookProc(INT, UINT, LPMSG);
LONG DoDestroy(HWND, UINT, UINT, LONG);
LONG DoPaint(HWND, UINT, UINT, LONG);
LONG DoClose(HWND, UINT, UINT, LONG);
LONG DoCommand(HWND, UINT, UINT, LONG);
LONG DoHelpContext(HWND, UINT, UINT, LONG);
LONG DoMenuExit(HWND, UINT, UINT, LONG);
LONG DoMenuHelpContents(HWND, UINT, UINT, LONG);
LONG DoMenuHelpSearch(HWND, UINT, UINT, LONG);
LONG DoMenuHelpHelp(HWND, UINT, UINT, LONG);
LONG DoMenuHelpAbout(HWND, UINT, UINT, LONG);
```



Figure 1: The header file for the Windows Help system demonstration application, DEMOAPP.EXE.

DEMOAPP.C

1 of 2

```
// DEMOAPP.C - Windows Help Demonstration Application
// Copyright (C) 1993 Ray Duncan
// PC Magazine * Ziff Davis Publishing
```

```
#define dim(x) (sizeof(x) / sizeof(x[0])) // returns no. of elements
```

```
#include "windows.h"
#include "demoapp.h"
```

```
// string used to allocate private message number
// for use by application's windows hook callback
#define HOOKMSGSTRING "HelpHookMessage"
```

```
// context ID for context-sensitive help, must be
// synchronized with the [MAP] section of HPJ file.
#define MENU_INDEX_HELP 1
```

```
TCHAR szShortName[] = TEXT("DemoApp"); // short application name
TCHAR szAppName[] = TEXT("Help Demo"); // long application name
TCHAR szMenuName[] = TEXT("DemoAppMenu"); // name of menu resource
TCHAR szIconName[] = TEXT("DemoAppIcon"); // name of icon resource
TCHAR szHelpName[] = TEXT("demoapp.hlp"); // name of help file
```

```
//
// Table of window messages supported by FrameWndProc()
// and the functions which correspond to each message.
```

```
struct decodeUINT messages[] = {
    0, DoHelpContext,
    WM_PAINT, DoPaint,
    WM_COMMAND, DoCommand,
    WM_DESTROY, DoDestroy,
    WM_CLOSE, DoClose, };
```

```
//
// Table of menubar item IDs and their corresponding functions.
```

```
struct decodeUINT menuitems[] = {
    IDM_EXIT, DoMenuExit,
    IDM_HELPCONTENTS, DoMenuHelpContents,
    IDM_HELPSEARCH, DoMenuHelpSearch,
    IDM_HELPONHELP, DoMenuHelpHelp,
    IDM_HELPABOUT, DoMenuHelpAbout, };
```

```
// far pointer to windows hook callback
WNDPROC lpfnWindowsHookProc;
```

```
// handle for frame window
HWND hFrame = NULL;
```

```
// program instance handle
HANDLE hInst;
```

```
// handle for Windows hook function
HHOOK hWindowsHook;
```

```
// handle for menu bar accelerator key table
HANDLE hAccel;
```

```
//
// WinMain -- entry point for this application from Windows.
```

```
//
// APIENTRY WinMain(HANDLE hInstance,
// HANDLE hPrevInstance, LPSTR lpCmdLine, INT nCmdShow)
```

```
{
    MSG msg;

    hInst = hInstance; // save this instance handle

    if(!hPrevInstance) // if first instance,
        if(!InitApp(hInstance)) // register window class
            return(FALSE); // exit if couldn't register

    if(!InitInstance(hInstance, nCmdShow)) // create this instance's window
        return(FALSE); // exit if create failed

    while(GetMessage(&msg, NULL, 0, 0)) // while message != WM_QUIT
    {
        if(!TranslateAccelerator(hFrame, hAccel, &msg))
        {
            TranslateMessage(&msg); // translate virtual key codes
            DispatchMessage(&msg); // dispatch message to window
        }
    }

    Terminate(hInstance); // clean up for this instance
    return(msg.wParam); // return code = WM_QUIT value
}
```

```
//
// InitApp --- global initialization code for this application.
```

```
//
// BOOL InitApp(HANDLE hInstance)
```

```
{
    WNDCLASS wc;

    // set parameters for frame window class
```

```
    wc.style = CS_HREDRAW|CS_VREDRAW; // class style
    wc.lpfnWndProc = FrameWndProc; // class callback function
    wc.cbClsExtra = 0; // extra per-class data
    wc.cbWndExtra = 0; // extra per-window data
    wc.hInstance = hInstance; // handle of class owner
    wc.hIcon = LoadIcon(hInst, szIconName); // application icon
    wc.hCursor = LoadCursor(NULL, IDC_ARROW); // default cursor
    wc.hbrBackground = GetStockObject(WHITE_BRUSH); // background color
    wc.lpszMenuName = szMenuName; // name of menu resource
    wc.lpszClassName = szShortName; // name of window class

    return(RegisterClass(&wc)); // register class, return status
}
```

```
//
// InitInstance() -- instance initialization code
//
// BOOL InitInstance(HANDLE hInstance, INT nCmdShow)
```

```
{
    hFrame = CreateWindow( // create frame window
        szShortName, // window class name
        szAppName, // text for title bar
        WS_OVERLAPPEDWINDOW, // window style
        CW_USEDEFAULT, CW_USEDEFAULT, // default position
        CW_USEDEFAULT, CW_USEDEFAULT, // default size
        NULL, // no parent window
        NULL, // use class default menu
        hInstance, // window owner
        NULL); // unused pointer

    if(!hFrame) return(FALSE); // error, can't create window
```

```
// Load menu bar accelerator key table
if(!hAccel = LoadAccelerators(hInst, "DemoAppAcc"))
    return FALSE;
```

```
// allocate private message number for use by
// windows hook callback procedure
messages[0].Code =
    RegisterWindowMessage((LPSTR) HOOKMSGSTRING);
```

```
// give up if can't allocate private message
if(messages[0].Code == 0)
    return(FALSE);
```

```
// allocate thunk for windows hook callback
lpfnWindowsHookProc =
    MakeProcInstance((WNDPROC) WindowsHookProc, hInst);
```

```
// bail out if thunk allocation failed
if(lpfnWindowsHookProc == NULL)
    return(FALSE);
```

```
// register windows hook callback and save handle
hWindowsHook = SetWindowsHookEx(WH_MSGFILTER,
    lpfnWindowsHookProc, hInst, GetCurrentTask());
```

```
ShowWindow(hFrame, nCmdShow); // make frame window visible
UpdateWindow(hFrame); // force WM_PAINT message
return(TRUE); // return success flag
}
```

```
//
// TerminateInstance -- instance termination code for this application.
```

```
//
// BOOL TerminateInstance(HANDLE hInstance)
```

```
{
    // delete our windows hook function from global chain
    UnhookWindowsHookEx(hWindowsHook);

    // release the thunk for our windows callback
    FreeProcInstance(lpfnWindowsHookProc);

    return(TRUE); // return success flag
}
```

```
//
// FrameWndProc --- callback function for application frame window.
```

```
//
// LONG CALLBACK FrameWndProc(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
```

```
{
    INT i; // scratch variable

    for(i = 0; i < dim(messages); i++) // decode window message and
    { // run corresponding function
        if(wMsg == messages[i].Code)
            return(messages[i].Fxn)(hWnd, wMsg, wParam, lParam);

        // or hand off to Windows
        return(DefWindowProc(hWnd, wMsg, wParam, lParam));
    }
}
```

```
//
// DoCommand -- process WM_COMMAND message for frame window by
// decoding the menubar item with the menuitems[] array, then
// running the corresponding function to process the command.
```

```
//
// LONG DoCommand(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
```

```
{
```

Figure 2: The source code for DEMOAPP.EXE.

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DEMOAPP.C

2 of 2

```

INT i; // scratch variable

for(i = 0; i < dim(menuitems); i++) // decode menu command and
{ // run corresponding function
    if(wParam == menuitems[i].Code)
        return((*menuitems[i].Fxn)(hWnd, wParam, lParam));
}

return(DefWindowProc(hWnd, wParam, lParam));
}

//
// DoDestroy -- process WM_DESTROY message for frame window.
//
LONG DoDestroy(HWND hWnd, UINT wParam, LONG lParam)
{
    PostQuitMessage(0); // force WM_QUIT message to
    return(FALSE); // terminate the event loop
}

//
// DoPaint -- process WM_PAINT message for frame window.
//
LONG DoPaint(HWND hWnd, UINT wParam, LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    RECT rect;
    HFONT hfont;

    hdc = BeginPaint(hWnd, &ps); // get device context
    GetClientRect(hWnd, &rect); // get client area dimensions
    hfont = CreateFont(-36, 0, 0, 0, 700, // get handle for pretty font
        TRUE, 0, 0, ANSI_CHARSET,
        OUT_DEFAULT_PRECIS, CLIP_DEFAULT_PRECIS,
        DEFAULT_QUALITY, (FF_MODERN << 4) + DEFAULT_PITCH,
        TEXT("Arial"));
    SelectObject(hdc, hfont); // realize font in DC
    DrawText(hdc, TEXT("Windows Help Demo App"), -1, // paint text
        &rect, DT_CENTER | DT_VCENTER | DT_SINGLELINE); // in window
    EndPaint(hWnd, &ps); // release device context
    return(FALSE); // terminate the event loop
}

//
// DoClose -- process WM_CLOSE message for frame window.
//
LONG DoClose(HWND hWnd, UINT wParam, LONG lParam)
{
    // shut down help file viewer if running
    WinHelp(hWnd, szHelpName, HELP_QUIT, 0);

    // destroy the frame window
    DestroyWindow(hWnd);
    return(FALSE);
}

//
// DoMenuExit -- process File-Exit command from menu bar.
//
LONG DoMenuExit(HWND hWnd, UINT wParam, LONG lParam)
{
    SendMessage(hWnd, WM_CLOSE, 0, 0); // send close message
    return(FALSE); // to shut down the app
}

//
// DoMenuHelpContents -- process Help-Contents command from menu bar.
//
LONG DoMenuHelpContents(HWND hWnd, UINT wParam, LONG lParam)
{
    WinHelp(hWnd, szHelpName, HELP_INDEX, 0);
    return(FALSE);
}

//
// DoMenuHelpSearch -- process Help-Search for... command from menu bar.
//
LONG DoMenuHelpSearch(HWND hWnd, UINT wParam, LONG lParam)
{
    WinHelp(hWnd, szHelpName, HELP_PARTIALKEY, (LONG) (LPSTR) "");
    return(FALSE);
}

//
// DoMenuHelpHelp -- process Help-How to Use Help command from menu bar.
//
LONG DoMenuHelpHelp(HWND hWnd, UINT wParam, LONG lParam)
{
    WinHelp(hWnd, "WINHELP.HLP", HELP_HELPONHELP, 0);
    return(FALSE);
}

//
// DoMenuHelpAbout -- process Help-About command from menu bar.
//
LONG DoMenuHelpAbout(HWND hWnd, UINT wParam, LONG lParam)
{
    WNDPROC lpProcAbout; // scratch pointer

    lpProcAbout = MakeProcInstance((WNDPROC) AboutDlgProc, hInst);
    DialogBox(hInst, TEXT("AboutBox"), hWnd, lpProcAbout);
    FreeProcInstance(lpProcAbout);
    return(FALSE);
}

//
// AboutDlgProc -- callback routine for About... dialog
//
BOOL CALLBACK AboutDlgProc (HWND hWnd, UINT msg, UINT wParam, LONG lParam)
{
    if((msg == WM_COMMAND) && (wParam == IDOK))
        EndDialog(hWnd, 0);
    else
        return(FALSE);
}

//
// DoHelpContext() -- this routine is called by
// FrameWndProc() for processing of the private message
// sent by the windows hook procedure. It
// invokes the help file viewer with a context ID
// in order to deliver context-specific help.
//
LONG DoHelpContext(HWND hWnd, UINT wParam, LONG lParam)
{
    WinHelp(hWnd, szHelpName, HELP_CONTEXT, MENU_INDEX_HELP);
    return(FALSE);
}

//
// WindowsHookProc -- windows hook callback function.
// This function must be registered with SetWindowsHookEx()
// and exported in the application DEF file.
//
DWORD CALLBACK WindowsHookProc(INT nCode, UINT wParam, LPMSG lpMsg)
{
    // bail out if callback unknown type or if pointer
    // to message structure is not valid
    if((nCode < 0) || !lpMsg)
        return(CallNextHookEx(hWindowsHook, nCode, wParam, lpMsg));

    // check if this is F1 keypress during a menu popup
    if(nCode == MSGF_MENU)
        if((lpMsg->message == WM_KEYDOWN) &&
            (lpMsg->wParam == VK_F1))
        {
            // yes, post private message number to
            // our frame window's message handler
            PostMessage(hFrame, messages[8].Code,
                nCode, lpMsg->hwnd);
        }

    // pass message on to the other windows hooks procs in chain
    return(CallNextHookEx(hWindowsHook, nCode, wParam, lpMsg));
}

```

The hook needs to monitor the event contexts and message contents and, whenever it detects a situation that requires context-sensitive help, call `PostMessage()` using the private message number previously allocated to notify the main message handler. The message handler, in its turn, must check for the private message number and, whenever that number is encountered, call `WinHelp()`

with the command `HELP_CONTEXT` and the integer identifier for the context-specific help file topic that should be displayed to the user.

There are several important aspects of hook procedures that I should warn you about. The actions that can be taken by a hook procedure are extremely constrained; for example, you can't simply call `WinHelp()` from the hook procedure

directly (although this would certainly be much more convenient). Furthermore, you must be careful to use `PostMessage()` rather than `SendMessage()` within a hook procedure, since calls to `SendMessage()` could lead to race conditions or to pathologically nested entries to the hook procedure. Lastly, hooks for message events are the only type of hook callback procedure that can be located in an application;

all other hooks must be located in DLLs.

There's one more issue related to context-sensitive help I've glossed over until now—the need to keep the help topic identifiers synchronized between the help project (.HPJ) file and the application source files. If your help file is not very big and the number of context-specific topics not very large, you can resort to the brute force method: manually updating the [MAP] section of the .HPJ file and adding #define statements to the application header file whenever necessary. However, Microsoft has made it possible to keep the identifiers synchronized in a much more elegant fashion. You can create a special file that contains only #define statements for the context strings and integer identifiers, for example

```
#define menu_index 1
```

You can then #include this file in your application source file or its header file

in the usual way, and also make it known to the help compiler by placing an #include statement immediately after the [MAP] header in the .HPJ file. Although the help compiler doesn't allow #include statements anywhere else, it will honor them in the [MAP] section, and it simply ignores the #define keywords.

THE DEMOAPP PROGRAM In order to demonstrate all the Help system techniques that we've just reviewed in a concise way, I've created a simple Windows application called DemoApp. The application does little more than paint a pretty message in its window, but it has a regulation Help menu, installs a hook procedure, and supports context-sensitive help. The files required to build DEMOAPP and its associated help file are: DEMOAPP.H, DEMOAPP.C, DEMOAPP.RC, and DEMOAPP.DEF (Figures 1 through 4, respectively); DEMOAPP.DOC, the WinWord source text for the application help file; DEMO-

DEMOAPP.RC

Complete Listing

```
// Resource script for DemoApp.C

#include "windows.h"
#include "DemoApp.h"

DemoAppIcon ICON DemoApp.ico

DemoAppMenu MENU
BEGIN
    POPUP            "&File"
    BEGIN
        MENUITEM     "E&xit",        IDM_EXIT
    END
    POPUP            "&Help"
    BEGIN
        MENUITEM     "&Contents",      IDM_HELPCONTENTS
        MENUITEM     "&Search for Help on...", IDM_HELPSEARCH
        MENUITEM     "&How to Use Help",  IDM_HELPONHELP
        MENUITEM     SEPARATOR
        MENUITEM     "&About DemoApp...",  IDM_HELPABOUT
    END
END

DemoAppAcc ACCELERATORS
BEGIN
    VK_F1, IDM_HELPCONTENTS, VIRTKEY
END

AboutBox DIALOG, 23, 19, 186, 61
CAPTION "About DemoApp..."
STYLE DS_MODALFRAME | WS_CAPTION | WS_SYSMENU
BEGIN
    ICON "DemoAppIcon", -1, 12, 9, 16, 16, WS_CHILD | WS_VISIBLE
    CTEXT "Microsoft Windows", -1, 33, 7, 64, 8
    CTEXT "Help Demo Application", -1, 38, 18, 68, 9
    CTEXT "\251 1993 Petit Mal Software", -1, 9, 38, 87, 9
    CONTROL "OK", IDOK, "BUTTON", WS_GROUP, 36, 43, 32, 14
END
```

Figure 3: The resource script for DEMOAPP.EXE.

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APP.RTF, the RTF source text for the application help file; and DEMOAPP.HPJ, the project control file for the application help file. You can download all of these files, as well as the executable DEMOAPP.EXE and the compiled DEMO APP.HLP, from PC MagNet's Programming forum archived as DEMOAP.ZIP.

MORE READER MAIL ABOUT WINHELP As I did in my previous column, I've selected a few of the letters I have received about my recent Help columns to print here.

I've learned a lot from your Windows Help columns, but there's one topic you haven't covered. How do you create the nonmoving title bar shown in Figures 1, 2, and 3 of your column "Four Techniques to Enhance Your Windows Help Files" (June 15, 1993)? It appears directly below the Help buttons and displays the help topic title without a scroll bar. I've seen it before in Borland's C++ Help, but I can't find a reference that tells me how to create it. Is there a relatively simple way to implement it?

*Trevor Harmon
via CompuServe*

I've encountered a small problem creating help files. When I use Version 3.10.445 of the Microsoft Help compiler, which comes with Borland C++, Version 3.1, I sometimes get error messages during compilation of the following type:

```
Warning 4792: topic...25 of
upfe01.rtf : Non-scrolling region
defined after scrolling region.
```

I've carefully examined the source document to make sure that the last carriage return was not formatted as hidden text, but I still get these errors. I can't see any difference between the pages of the RTF file that generate these warnings and those that don't. I've been using Microsoft Word 2.0c and saving the help document as an RTF file. When I check the help file using the help file viewer in Windows 3.1, everything works fine; I haven't noticed any problems with the help file.

What causes these warnings during the compilation of the help file? Should I worry about them if the help file works?

*Jon Harvie
via CompuServe*

```

NAME      DemoApp

DESCRIPTION 'DemoApp - Demonstrates Windows Help in Application'

EXETYPE    WINDOWS

STUB       'WINSTUB.EXE'

CODE       PRELOAD MOVEABLE
DATA       PRELOAD MOVEABLE MULTIPLE

HEAPSIZE   32768
STACKSIZE  8192

EXPORTS
  FrameWndProc
  AboutDlgProc
  WindowsHookProc

```

Figure 4: The module definition file for DEMOAPP.EXE.

Both of these questions are related to the same Help system capability. If one or more paragraphs at the beginning of a topic are marked with the "keep with next" attribute, they will be displayed together in a nonscrolling region at the top of the WINHELP window, and the remainder of the topic text will be displayed in a scrollable region underneath. In order to take advantage of this capability when you are working in WinWord, select the paragraph(s) at the beginning of the topic, choose Format-Paragraph from the menu bar, and then turn on the "keep with next" checkbox in the resulting dialog. If you are editing your help source text directly in RTF, use the "\keepn" command. The error message encountered by Mr. Harvie is emitted by the help compiler when it finds a paragraph with the "keep with next" attribute after a paragraph without this attribute in the same topic. This doesn't cause any ill effects and is basically ignored by the help compiler.—RD

I have one suggestion relating to your recent WinHelp articles. For the HelpOnHelp menu item, a null pointer can be used for the second parameter in the call to WinHelp() instead of a far pointer to the WINHELP.HLP filename. I found this out just by trying it. This method could prove better than hard-coding the filename just in case Microsoft decides to change the names of its files for some reason (such as when the operating system

no longer restricts them to the 8.3 filename convention).

*Duanfeng He
via Internet*

This is correct. The WinHelp() HELP_HELPONHELP command does work as expected in spite of a NULL pointer for the help filename, although this is not documented in the Windows 3.1 SDK Functions Reference.—RD

Here's a tip for anyone using Ami Pro 3.0. Protected Text in Ami Pro is the same as Hidden Text in Word for Windows. To format text in this way, highlight the text, then choose Edit, Mark Text, Protected Text.

In addition, if you have questions about building Help Files using Ami Pro, you can download HELP30.EXE in the Lotus Development Corp.'s Word Processing Forum on CompuServe. It contains stylesheets and macros that are useful in creating a help file. (HELP30.EXE does not contain the help compiler HC31.EXE; that has to be downloaded separately from the Microsoft forums.)

*Daniel Kurzweil
via CompuServe*

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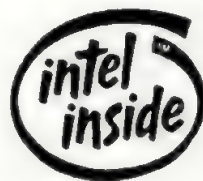
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SHOULD YOU PUSH THE PROCESSOR?

❷ I recently purchased a 486DX2-66 system through my company's employee purchase program. Friends who bought 486SX-25 systems discovered that they could get their systems to run at 40 MHz just by moving a jumper on the motherboard. I tried moving the same jumper, but my system wouldn't boot. I was able to boot from a floppy disk, and when I ran QAPLUS diagnostic software, the system was indeed running at an incredible 88 MHz! Since I couldn't get the rest of the system to work properly at this speed, I resentfully switched the jumper back and now I have to settle for a measly 66 MHz again. Is there any way to make my system work at the higher speed?

*Rick L. Warrant
Atlanta, Georgia*

► **PC MAGAZINE:** To paraphrase a former president: You could do that...but it would be wrong. What you're trying to do is run the components at a higher clock speed than the system designers intended. This process is at least as old as microcomputers themselves, and is known as *pushing* the design. There is an honest difference of opinion about the merits of this practice, but most experts seem to oppose it.

In the early days of PCs, the system clock relied on one or more crystals on the motherboard to provide timing signals. In the IBM PC, these were soldered in place. When IBM released the AT, however, it used a socket for the main crystal. Enterprising users discovered

that they could easily replace this with a faster crystal to get improved performance. In fact, you could buy "speed up kits," which were simply collections of crystals with different speeds. To find the fastest crystal your system could handle, you just kept swapping crystals with the next faster one until the system wouldn't boot, and then you'd use the last one that worked. For the IBM AT, this was usually an 8-MHz or 10-MHz crystal. IBM wised up to this practice and began soldering the crystals into the later AT motherboards.

Over the years we've seen vendors push their designs in order to save money or get a performance edge in benchmark tests. Some even went so far as to sand off or paint over the speed ratings on their chips to prevent users from finding out the component's rated speed. While this meant that the components were being used outside the manufacturers' specifications, the systems did appear to operate satisfactorily.

Modern motherboards are designed

to be far more flexible than their progenitors. The fact that you have the same jumper on your 486DX2-66 system as your friends' 486SX-25 machines is a strong indication that your systems are probably using the same motherboard. To save money, computer designers have come up with motherboard designs that can accommodate a range of processors running at varying clock speeds. Rather than use a different crystal for each processor speed, they use a single crystal and provide circuits that synthetically create the desired clock signal. The jumper you were moving was apparently setting the motherboard to operate at 44 MHz, which in turn was doubled by your DX2 CPU for its internal operations. The fact that your friends are running at 40 MHz with the jumper in that position indicates that there are other jumpers affecting the clock speed.

While it's true that you may be able to run your CPU at a speed faster than its rating, the same may not be true for the rest of your components. Early push

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See index, page 427.

designs demonstrated that there were limits to how fast expansion cards could be run, for example. Since your system's expansion bus speed is probably determined by the system clock speed, you may be running your cards faster than they're designed to go. It's also possible that you'll select a faster speed than the motherboard components can handle.

Despite all this, there's a chance you can make your push design work. Start by getting the technical details about the motherboard so you understand the function of all the clock speed jumpers, then advance the speed until it fails to work. You might be able to go beyond this by changing the Advanced CMOS settings, if they are available, to lower the expansion bus speed to 8 MHz or so. See "Hidden Problems With Scrambled CMOS," which appeared in the April 27, 1993, Solutions column, for details on how to do this. By carefully advancing the system speed while keeping the expansion bus speed under control, you may get a free performance upgrade.

Free doesn't mean that there is no cost, however. You will be running the system outside of its specifications. First and foremost, this will likely void your manufacturer's warranty. More than that, though, is the problem of heat. Heat is the number one enemy of electronic components, and running a chip at a higher speed increases the heat and can lead to temporary or permanent component failures. The question to ask yourself is whether the boost in performance is worth the increased risk of system failure. Most people take a fairly conservative view of this equation and opt to leave their systems running at the speeds they were designed for.—*Alfred Poor*

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40 SYS.

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Ethan Winor is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

as they are executed. Now I'm trying to learn about assembly and machine language using DEBUG, and it would be a great help to have a similar facility to

trace the execution of program files, and either display the segment:offset flow of execution on-screen or write it to an ASCII file.

I've tried using DEBUG's Trace function, but it gets lost when it encounters an INT instruction. Replacing interrupt calls with NOP instructions prevents the following instructions from receiving results that the INT routine should be providing for them.

As a student on a budget, I'm not able to buy sophisticated programming tools. Do you have any suggestions?

J. W. Bruce
Omaha, Nebraska

► **PC MAGAZINE:** It seems that the two most common uses for DEBUG these days are assembling tiny .COM programs and patching text messages in other programs. Its original purpose—debugging programs—is almost forgotten. That's because DEBUG's features are meager indeed compared with the features of modern debuggers like CodeView and Turbo Debugger. But you can use DEBUG as a simple debugger if you learn just a few of its instructions.

As Mr. Bruce notes, once a program

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Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Or maybe you'd like a better understanding of how something works. If so, we invite you to let us know about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

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HOW TO TRACE PROGRAMS WITH DEBUG

❗ You've published many tips for using DEBUG, but here's a problem I don't think you've covered. IBM BASICA has a handy program-execution tracing function that displays program line numbers

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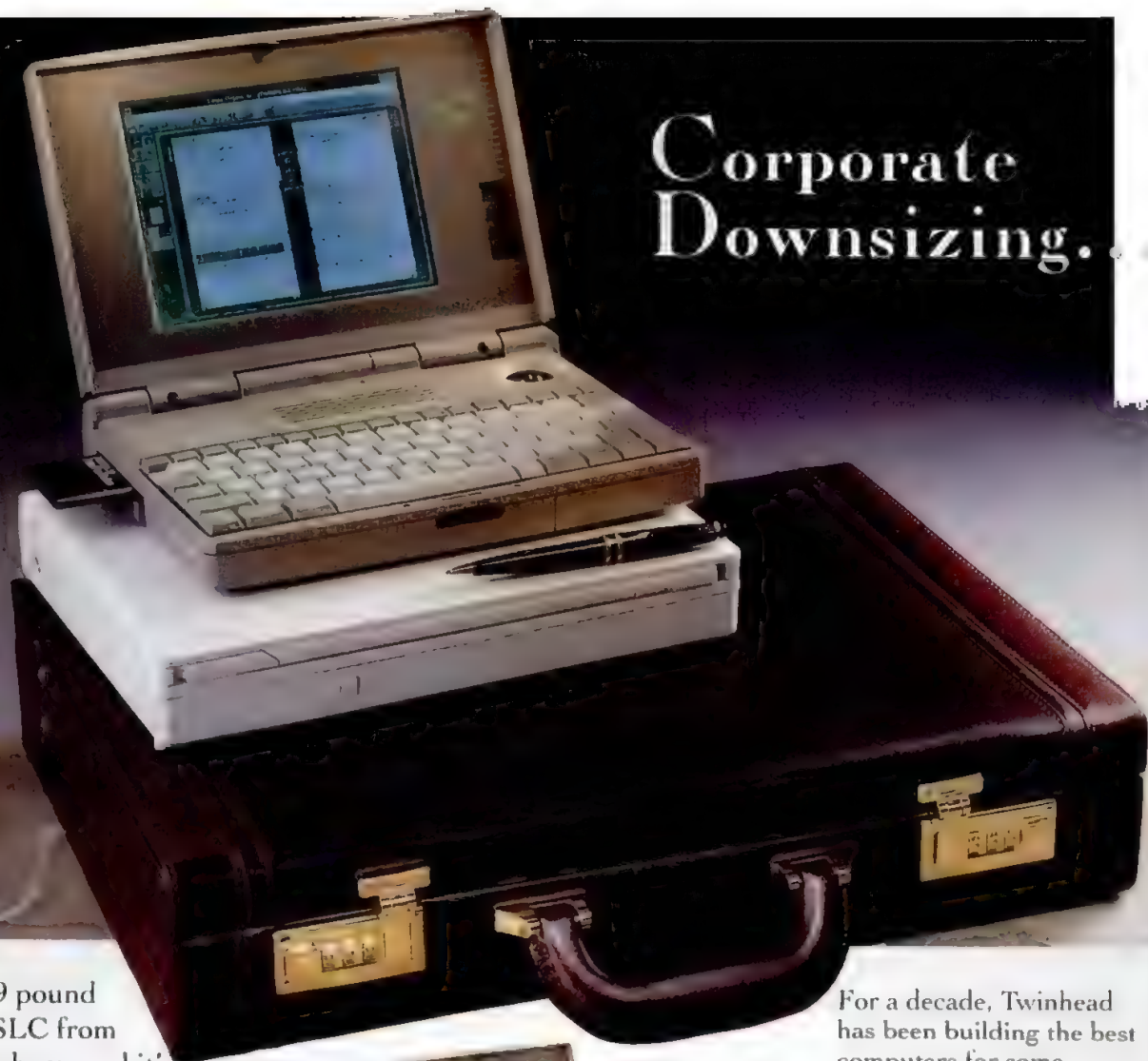
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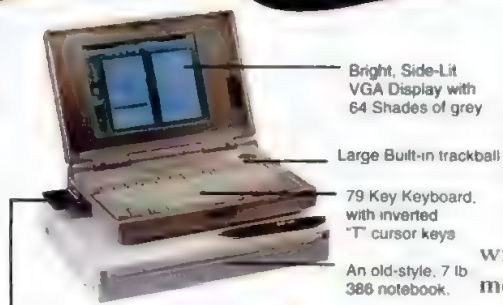
CIRCLE 347 ON READER SERVICE CARD



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The new 3.9 pound SubNote 4SLC from Twinhead is here, and it's ready to travel! With a 486 CPU, 4Mb of RAM, DOS 6.0 and Microsoft Windows, the SubNote is ready to tackle your work, faster than any old 386 notebook. Just because SubNote is small, don't think for a second that you have to compromise on features. 33MHz speed, 4 hour battery life, built-in trackball, and a bright, readable screen with 64 shades of gray, are all standard features. The SubNote was designed from the ground up as a full-featured notebook, yet it measures only 7.1" x 10" x 1.6" (DWH).



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CIRCLE 393 ON READER SERVICE CARD

is loaded into DEBUG, you can trace through it one instruction at a time with the T (for Trace) command. After each T command, DEBUG displays the values of all the CPU registers and the statement that will be executed next. However, if you trace into an INT (interrupt) instruction, you'll find yourself tracing the internals of DOS or the system BIOS rather than your program. When the next instruction that's displayed is an INT, use the P (for Proceed) command rather than T. This causes DEBUG to *execute* the interrupt call and then proceed to the next statement in your program.

G (for Go) is another useful instruction. Enter G followed by an address within your program and DEBUG will execute the program until it reaches that address and then stop. Actually, you can specify up to ten breakpoint addresses after the G command, and DEBUG will stop when any one of them is reached.

This instruction-at-a-time debugging can make it difficult to grasp just what the program is *doing*. Enter U (for Unassemble) followed by a starting address

and DEBUG will unassemble the 32 bytes of code beginning at that address. You can control the length of the unassembly by also specifying an ending address, or by adding the letter L followed by the number of bytes to unassemble. For example, the command U CS:100 L 30 will unassemble the first 48 bytes (30 hexadecimal) of a program.

You can combine the U command with DOS redirection and some careful typing to use DEBUG as a disassembler for .COM programs. Here's how to do it: Load the program into DEBUG and type RCX, then press Enter twice. The number displayed by DEBUG is the file's size. Write it down or remember it, then give the Q command to quit DEBUG. Now load the program into DEBUG again, but redirect output to, for example, an .LST file:

DEBUG MYPROG.COM > MYPROG.LST

Because output is redirected, you won't see anything on the screen, but you can carefully type commands to DE-

BUG. Type U CS:100 L followed by the length value you noted, and press Enter. DEBUG will unassemble your program from the initial loading address (CS:100) for as many bytes as the entire length of the file, and the result will be stored in MYPROG.LST. Enter Q to quit DEBUG. You can print the .LST file or examine it at your leisure. DEBUG isn't a perfect disassembler—it treats every byte as code, even those meant to be data. But don't forget, it's free with DOS!—Neil J. Rubenking

A CAPSLOCK UTILITY FOR WINDOWS

❓ You presented the TSR utility CAPSLOCK.COM in the November 12, 1991, User-to-User column. I've used it ever since, especially whenever I fired up Microsoft Word 5.0.

Recently I switched to Word for Windows 2.0 because I needed graphics, and since then CAPSLOCK hasn't worked. I've tried loading it before, during, after,

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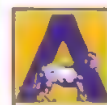
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CIRCLE 235 ON READER SERVICE CARD

and any other way you can think of, but nothing helps. There's something about the Windows environment that keeps CAPSLOCK from working. Do you have any suggestions?

C.B. Lester
Longview, Texas

► **PC MAGAZINE:** Normally, using a shifted alphabetic key while Caps Lock is on generates a lowercase character. But doing so with CAPSLOCK.COM loaded generates a capital letter and turns off Caps Lock, just as it does on a typewriter. The CAPSLOCK utility works by taking over the keyboard interrupt; it gets information from the keyboard before the built-in keyboard interrupt handler. In most cases, CAPSLOCK simply passes the keyboard information to the previous interrupt handler, but if a Shift key happens to be pressed, it takes special action.

Under DOS it's possible for many RAM-resident programs to peek at the keyboard information to see, for example, whether a hotkey combination was pressed. Each program simply passes the keyboard information to the previous interrupt handler in the chain.

This system breaks down under Windows, though, because Windows completely takes over the processing of keyboard input. It does not pass any information to any programs that were loaded previously. When Windows is running, it's totally in charge. To modify the keyboard input, a program needs to hook into Windows, not into the keyboard interrupt.

Fortunately there's at least one Windows solution: WINKEY, from DataGem software. WINKEY can be configured to operate exactly like CAPSLOCK, but it works in Windows. It also lets you set NumLock and ScrollLock to be always on or always off, and optionally switches the Ctrl and Caps Lock keys. WINKEY is a shareware program, with a \$15 registration fee. You can download an evaluation copy of WINKEY.ZIP from PC MagNet's Utilities/Tips Forum (GO ZNT:TIPS), the Windows + OS/2 Utils Library (Lib 15), or if you would like to order the product directly, contact DataGem Corp., 1420 NW Gilman, #2859, Issaquah, WA 98027; 206-391-4415.—Neil J. Rubenking

Word Processing

WP WIN'S PROBLEMS WITH HI-RES DRIVERS

✓ **TIP** For the first few days after getting our new 486 systems, complete with WordPerfect for Windows and high-resolution graphics monitors, we suffered a lot of apparently random crashes. Macros and Help wouldn't run reliably, and we couldn't zoom to 50 percent reliably, among other problems.

WordPerfect's technical support recognized the problem, and told us to add the /FL switch. The switch was part of the 4/30/92 interim release of WordPerfect for Windows 5.1 and is meant to solve problems that crop up with 256-color drivers. Unfortunately, the switch doesn't seem to be documented.

To check if you've got the 4/30/92 interim release, launch WordPerfect, then choose Help | About WordPerfect to reveal the program release date. To install the /FL switch, go to the Program Manager, choose the WPWIN icon, then choose File | Properties. Move to the Command Line text box, add a single space, then /FL after WPWIN.EXE, and Choose OK. Now WordPerfect will start with the /FL switch.

William J. Wolfe
Champaign, Illinois

► **PC MAGAZINE:** This switch is actually documented in the README file in the 4/30/92 interim release. It's also available in WordPerfect for Windows 5.2, and is discussed in Appendix O of the Version 5.2 reference manual. However, the problem is still worth mentioning.

The documentation is a bit skimpy in any case, saying only that the switch prevents application errors with 256-color drivers and that it fixes display problems with some font packages, including ATI Crystal Fonts. (According to WordPerfect, Crystal Fonts may appear "chopped up" on-screen without the /FL switch, with parts of characters missing.)

It's important to note that these are two entirely separate classes of problems. WordPerfect says that without the /FL

switch, you may get Unrecoverable Application Errors (in Windows 3.0) or General Protection Faults (in Windows 3.1), with some 256-color drivers. As a separate issue, display problems, such as the problems with the ATI Crystal Fonts, may show up with any high-resolution driver—meaning anything more than 16-color VGA.

It's also important to note that if you use the switch, you're giving up something as well, so you should use it only if you really need it. The FL is short for *flash*. The switch is so named because it turns off a WordPerfect feature that's meant to eliminate the flashing or flickering that you might otherwise see on-screen. Set the switch on—which turns the feature off—and you will see the current line flash off and on with each keystroke as you enter or edit text.

You may also be able to eliminate either kind of problem, without adding flickering, simply by changing to a driver with either fewer or more colors. And you may not need the /FL switch even with a 256-color driver. A case in point: My system, which includes a Micrographics 32KVGA board, has no problem with the Micrographics 1,024-by-768 256-color driver, even without adding the /FL switch. But add the switch and the flickering quickly becomes a problem.

In general, you shouldn't add the switch unless you have unexplained crashes with a 256-color driver, or have unexplained display problems. And even then you might try switching drivers before deciding to put up with the flickering. According to WordPerfect, you are less likely to have problems in Windows 3.1 with drivers specifically written for 3.1. So if you have a driver left over from Windows 3.0, be sure to upgrade it—a good idea in any case.—M. David Stone

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technique that lets me do Monte Carlo simulations in Quattro Pro. These simulations repeatedly use random values in a calculation to approximate its results (Figure 1). In cells A3..B7 of this worksheet, I have a table of potential sales figures. The table is named SALE_DIST. The top-left value in this table is 0.0. The first value in the second column is 8.00, my lowest possible sales figure. The second value in the first column, 0.1, is my estimate of the probability that sales will be no greater than 8.00. The third value in the left column is the probability that sales will be no greater than the second value in the right column. The fourth value in the left column is the probability that sales will be no greater than the third value in the right column—and so on.

To the right of this table, in cells C3..D5, is a similarly constructed table of possible variable costs. This table is named VAR_COST. Below these tables, in cells A10..F19, is a five-year cash-flow model. The sales and variable-cost figures in this model are derived from @VLOOKUP formulas that use @RAND as the lookup index. The sales formulas, in C12..F12, are

`=6000*@VLOOKUP(@RAND,$SALE_DIST,1)`

and the cost formulas, in C13..F13, are

`=6000*@VLOOKUP(@RAND,$VAR_COST,1)`

MONTE.WB1
A1..F22

A	A	B	C	D	E	F
1	PROBABILITY TABLES:					
2	SALE_DIST		VAR_COST			
3	0.0	8.00	0.0	5.00		
4	0.1	13.00	0.3	6.00		
5	0.3	14.00	0.7	9.75		
6	0.5	15.00				
7	0.8	15.25				
8						
9	PROJECT MODEL:					
10	TIME	0	1	2	3	4
11	INVESTMENT	(450,000)				
12	SALES		84,000	90,000	48,000	78,000
13	VAR COST		30,000	30,000	36,000	36,000
14	FIXED COST		53,000	53,000	53,000	53,000
15	PRE TAX		1,000	7,000	(41,000)	(11,000)
16	AFTER TAX		600	4,200	(24,800)	(6,600)
17	TAX SHIELD		4,000	4,000	4,000	4,000
18	SALVAGE					600
19	CASHFLOW	(450,000)	172,600	188,200	75,400	154,000
20						
21	NPV		\$22,072			
22	IRR		12.64%			

Figure 1: The lookup table of sales and cost probabilities in the top of this worksheet is used to predict a business's cash flow over five years.

Just below the cash-flow model, in cells B21 and B22, are formulas that yield the net present value and internal rate of return for the model. I have named these cells NPV and IRR, respectively.

With the spreadsheet set up this way, I now have one possible outcome for my model. However, it is only one of many possible outcomes for this very simple case. To see some of the other outcomes, all that I have to do is hit the F9 key.

Simulation analysis is essentially a matter of collecting a sampling of possible outcomes. The trick for doing this turned out to be using a one-variable what-if table. I specified a data table three columns wide. In the first column, where various values are usually tried, I leave the cells empty. In the first row of the second and third columns, I have the formulas +NPV and +IRR, thereby refer-

MONTE.WB1						
A24..F45						
A	A	B	C	D	E	F
24	SAMPLE ANALYSIS					
25						
26		+NPV	+IRR			
27		37,093	14.59%		MAX	111,968
28		111,968	22.44%		MIN	(78,970)
29		77,088	18.35%		RANGE	190,938
30		27	10.00%		AVG	44,195
31		15,829	11.79%		STD	50,158
32		(14,303)	8.47%		COUNT	19
33		90,394	19.94%		FREQ DIST:	
34		101,881	21.46%		(75,000)	1
35		104,755	21.65%		(60,000)	0
36		37,516	14.11%		(45,000)	1
37		87,563	19.58%		(30,000)	1
38		7,038	10.88%		(15,000)	1
39		83,633	19.24%		0	2
40		14,079	11.44%		15,000	2
41		(11,529)	8.73%		30,000	5
42		84,397	19.37%		45,000	5
43		22,129	12.77%		60,000	0
44		69,121	17.42%		75,000	4
45		(78,970)	1.28%		90,000	2

Figure 2: The what-if table in A26..C45 leaves the first column blank to produce a Monte Carlo simulation, from which the statistical analyses and frequency distribution on the right are generated.

2, it occupies the range A26..C45, but it could just as easily have spanned several hundred rows.

From this what-if table of outcomes, it's an easy matter to generate descriptive statistics and a frequency distribution. Such an analysis appears in columns E and F of Figure 2.

Doug McCann
Jenkintown, Pennsylvania

► **PC MAGAZINE:** Two very clever things are going on here. The first is Mr. McCann's use of @RAND in conjunction with @VLOOKUP to generate inputs for the cash-flow model. Keep in mind that when Quattro Pro evaluates the @VLOOKUP function, it looks for the first value in the index range that is larger than the function's first argument. Then it backs up one row in the table, moves to the right the number of columns specified in the function's third argument, and returns whatever value it finds there. For example, if the first argument in Mr. McCann's sales-lookup formula were 0.25, Quattro Pro would scan through the index range (A3..B7) until it came to the first value greater than 0.25 (A5), fall back a row (to A4), move one column to the right (to B4) and return the value there—13.00.

The first argument in this @VLOOKUP function is @RAND,

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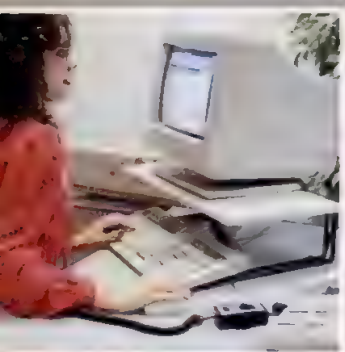
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A1..E11				
A	B	C	D	E
1	Principal	100000		
2	Interest			@PMT(B1,B2/12,B3*12)
3	Term	30		
4			7.00%	\$665.30
5			7.25%	\$682.18
6			7.50%	\$699.21
7			7.75%	\$716.41
8			8.00%	\$733.76
9			8.25%	\$751.27
10			8.50%	\$768.91
11			8.75%	\$786.70
			9.00%	\$804.62

Figure 3: This loan-calculating spreadsheet demonstrates the typical way what-if tables are set up.

which has an equal probability of returning any value between 0 and 1. If it happens to return anything up to 0.1, the function returns 8.00, which means there's a 10 percent chance that the function will return 8.00. If it returns anything between 0.1 and 0.3, the function returns 13.00, which means there's a 20 percent chance (0.3 to 0.1) that the function will return 13.00—and so on.

Thus, the outcomes in the sales and cost rows of the cash-flow model reflect the probabilities as Mr. McCann has defined them in the SALE_DIST and VAR_COST tables. If his estimate of the probability distribution changes, he has only to modify a few numbers in the SALE_DIST and VAR_COST tables.

The second flash of brilliance is Mr. McCann's use of blank (and therefore irrelevant!) inputs to the what-if table. Normally, we use what-if tables to substitute a series of constants into one or more formulas. These constants—for example, principal amounts or interest rates for a mortgage—are arrayed in the lefthand column of the table, and each constant is fed in turn into the formulas in the first row of the table.

Figure 3 shows a typical simple one-variable what-if table, and Figure 4 shows the What-If dialog box. The table is defined as the range D2..E11. The input cell is specified to be B2. The formula we want to evaluate—in this case a loan-payment formula, appears in E2, at the top of the second column, and is formatted in the Text format so that we can see

what's being calculated in the table. Notice that the formula references the table's input cell, B2, as the second argument of the @PMT function. Also notice that the input cell itself is blank. This is the typical setup for this kind of what-if table.

When Quattro Pro generates the table, it substitutes each value in the leftmost column of the table—6.00%, 6.25%, 6.50%, and

so on—into cell B2. Each time it does this, it calculates the formula in E2 and displays the result in one of the cells below E2. The result is a table that demonstrates the sensitivity of a mortgage payment to varying monthly rates of interest.

Now look again at the what-if table in Figure 2. Here the table is defined to be A26..C45, and the input cell is A25. Column A, the column that normally would hold the values to be substituted into the input cell, is blank. And the formulas at the top of the table—cells B26 and C26—don't even reference the input cell. This is most unconventional! When this table is generated, Quattro Pro simply recalculates the formulas at B26 and C26 once for each position in the table. Since those formulas reference cells (B21 and B22) that reference other cells that make use of @RAND, the net effect is to build a table of random trials—a Monte Carlo simulation.

Vendors of true Monte Carlo spreadsheet add-ins are not going to be put out of business by Mr. McCann's cleverness.

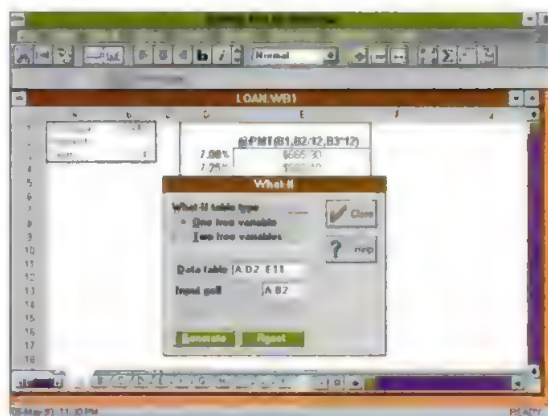


Figure 4: Quattro Pro for Windows displays this dialog box when you choose What-If from the Data menu.

Two such companies are Palisade Corp., maker of @RISK (31 Decker Rd., Newfield, NY 14867; 607-277-8000) and Decisioneering, maker of Crystal Ball (1380 Lawrence St., #610, Denver, CO 80204; 303-447-6464). Among other things, those programs allow you to run simulations with nonuniformly distributed random inputs. But Monte Carlo add-ins use memory and cost money, and to my knowledge, none of them works with either flavor of Quattro Pro.

—Craig Stinson

Databases

COUNTING GROUPS IN FOXPRO REPORTS

TIP In one of my applications, I needed a report that showed records grouped by certain criteria. This is easy enough to do using FoxPro's report writer. What did take me some time, however, was coming up with a way to count the number of groups on the report (not the number of records).

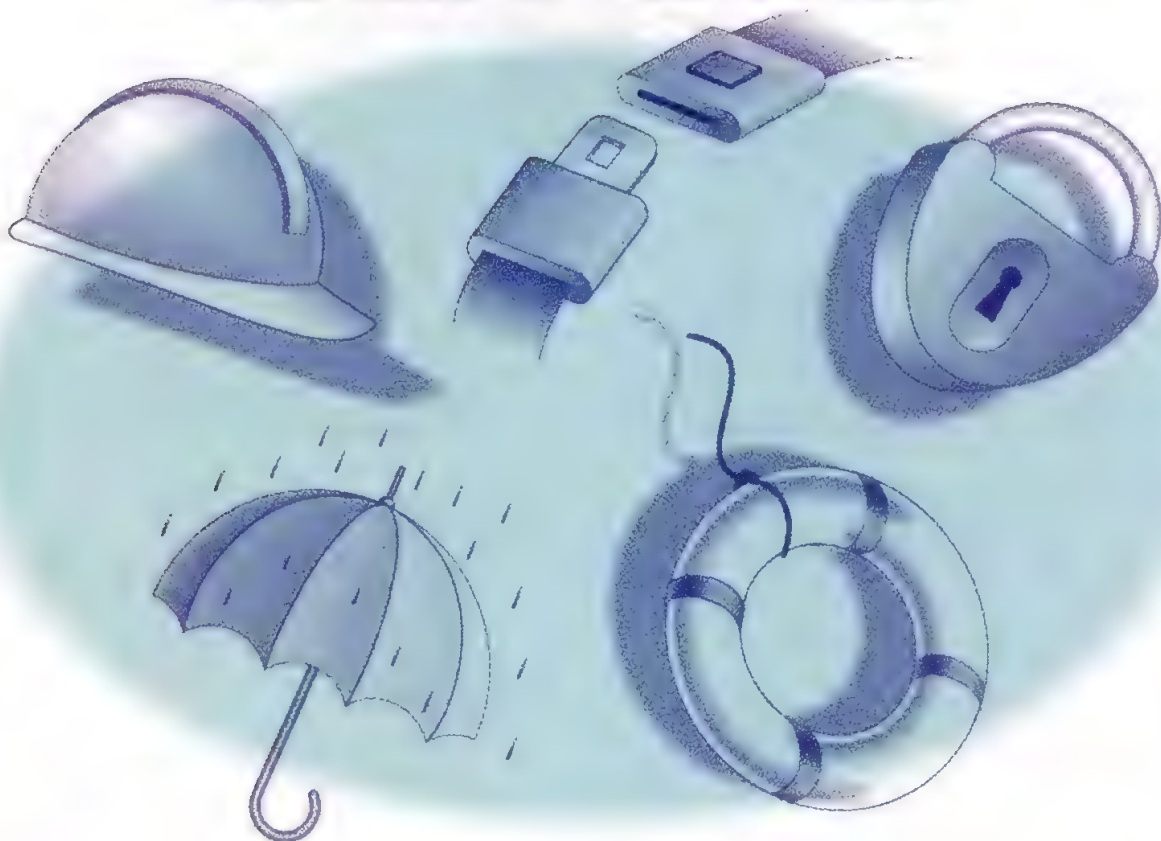
One solution is to define two report variables, one for the group counter, the other for the previous value of the group expression. For example, suppose you want to group a report on a field called Region, and you want to print a count of the total number of region groupings at the end of the report. To count the groups, you would add two report variables to the report as shown in Figure 5.

If you simply try to count the Region field, the count will be incremented after each record, not each group. Using the technique shown here, the count is incremented after each group. Note that you must define the report variables in the order shown.

Bogdan Neagu
Bucharest, Romania

► PC MAGAZINE: There are a number of ways to count the groups outside of the report writer. For example, if regions are stored in a separate table with one region per record, you could select that work area and store the result of the COUNT or CALCULATE CNT() command to a memory variable prior to running the re-

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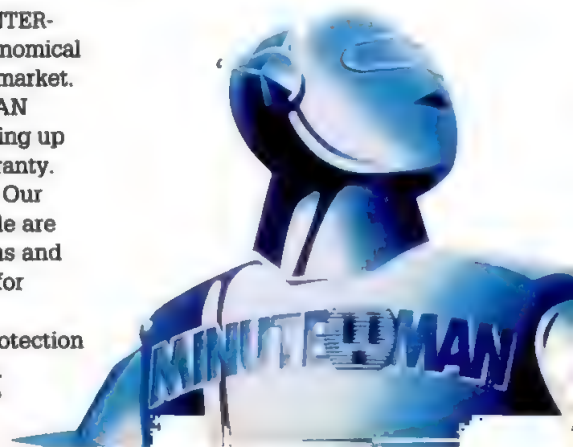
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Using a Report Variable's "Value to Store" Expression to Count Groups

Name	Value to store	Initial value	Reset	Calculate
Groupcnt	Groupcnt + IIF(Region == Oldreg, 0, 1)	1	End of Report	Nothing
Oldreg	Region	Region	End of Report	Nothing

Figure 5: One approach to counting groups in a report. The Groupcnt variable holds the total number of groups at the end of the report.

port (or the result from RECCOUNT() if you're not worried about including records marked for deletion), and then use that memory variable as a field in your report layout. You could also use something like

```
SELECT CNT(DISTINCT region)
FROM REGION;
INTO ARRAY nCount
```

You could then use nCount[1] in your re-

complete the resulting dialog box, shown in Figure 6. For each report variable, you must provide a name, a value to store, an initial value, a point at which the variable is reset to the initial value, and a calculation to perform.

FoxPro initializes the report variable to the value that you specify. Then, for every record in the detail band of your report, FoxPro evaluates the "Value to Store" expression, supplies the result to the calculation you specify, and then

stores the result of that to the named variable. Because the value you specify can be the result of a complex expression that includes things like IIF(), you have a wide degree of latitude regarding what you can do with the report variable.

To group records in a FoxPro report, you specify a group expression, such as the Region number used in the example. FoxPro prints detail records until it detects that the result of the group expression has changed, at which point it starts a new group; that is, it prints the group footer band, prints the group header band for the new group, and so on.

To count the number of groups in a report, you must detect when the value of the group expression changes. Then whenever you detect such a change, you can increment a counter, so that at the

end of the report, the counter will hold the total number of groups. The question is, how do you detect when the group expression changes?

Mr. Neagu's approach is to use a report variable to save the previous value of the group expression as FoxPro processes each record. That value is then compared with the result of the group expression after FoxPro moves to the current record. If the two are equal, FoxPro is still processing the same group. Otherwise a new group must have begun, in which case 1 can be added to the group counter.

In the example, the report is grouped on Region. The Groupcnt report variable holds the number of regions, and the Oldreg report variable holds the previous Region. FoxPro begins by setting each report variable to its initial value, so Oldreg is set to the first Region in the report, and Groupcnt is set to 1. Then FoxPro moves the record pointer to the first record and evaluates each report variable in order, first Groupcnt, then Oldreg.

For each detail record, the IIF() function in the Groupcnt variable is evaluated to see if the Region field in the current record is equal to the region stored in Oldreg. If it is, the IIF() returns 0. If it isn't, the IIF() returns 1. (You'll recall that the IIF() function evaluates its first argument and, if that is true, it returns the second argument. Otherwise it returns the third argument. In the example, if Region == Oldreg, 0 is returned. If Region is not equal to Oldreg, 1 is returned.) The result of the IIF(), either 0 or 1, is then added to the previous value of Groupcnt to produce a new total, because the Value to Store expression says "Groupcnt + IIF...". The result of the full expression is then stored to the Groupcnt variable. Thus, for each detail record, either 0 or 1 is added to the Groupcnt variable, with the 1 being added only when the group expression

Figure 6: You must complete this dialog box when you use a report variable in FoxPro. It asks for a name, a value to store, an initial value, a point at which the variable is reset to its initial value, and the calculation to perform.

port layout.

The disadvantage of these techniques is that they require placing your REPORT FORM command in a program in order to create the memory variable or array before you run the report. To make the calculation a part of the report design itself—thereby avoiding the need to enclose it in a program—you can use report variables.

A *report variable* is a memory variable that FoxPro creates and maintains while generating a report. To define a report variable, you select Variables from the Report menu, choose Add, and then

Setup for Group-Counting Report Variable Using Reset at Group

Name	Value to Store	Initial Value	Reset	Calculate
Groupcnt	IIF(Groupnew, 1, 0)	0	End of Report	Sum
Groupnew	.F.	.T.	Region	Nothing

Figure 7: Another approach to counting groups in a report. The Groupcnt variable holds the total number of groups at the end of the report.

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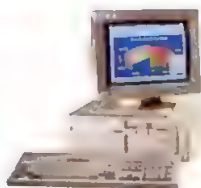
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changes. After processing Groupcnt, FoxPro processes Oldreg and sets it to the current region value. Then FoxPro moves the record pointer to the next detail record, and the process begins anew.

When you create a report variable, you tell FoxPro the point at which it can reset the variable to its initial value. FoxPro can reset the variable at the end of every page, at the end of the report, or before each new group (the Windows version can also reset at the end of a column). To reset on a group, you select the group expression from those listed when you create the variable.

The fact that FoxPro can reset a variable at the start of each new group forms the basis for an alternative to Mr. Neagu's approach. Figure 7 shows this alternative. Here the Groupnew report variable is initialized to .T., set to .F. during detail record processing, and then reset to .T. at each group break. The Groupcnt variable detects when Groupnew has been set to .T. and then increments accordingly. Note that in this example the Sum calculation is used rather than adding each value to the previous Groupcnt value within the "Value to Store" expression, as was done in the previous example. Either of these techniques will work fine, this one just simplifies the "Value to Store" expression.

It's important to emphasize that each "Value to Store" result contributes its value to the calculation chosen, if any. Using the second example, imagine three groups of ten detail records each. That means the "Value to Store" expression in Groupcnt will evaluate 3 times to 1 and 27 times to 0. Each of those 30 results contributes to the sum.

The order in which FoxPro processes the report variables is also important. All of the report variables are initialized at the beginning of the report. Then, for each detail record, FoxPro updates the report variables in order. Then at each group or page break, FoxPro checks for any variables that were scheduled to be reset and resets them to their initial values.

If you change the order of the variables in either example, the results will not be correct.

Keep in mind that you can create variables that are set to .T. at any of the avail-

able break events (page, group, column, end-of-report). You might use these, in turn, to perform other calculations.

—Sal Ricciardi

Graphics

INSTANT ART

TIP In a recent Solutions column you described how to save a company logo that was created in PageMaker 4.0 as an EPS graphics file ("EPS for Everyone," February 9, 1993), in order to make the logo available for use in a variety of different documents. I'd like to suggest an alternate approach.

You can convert your design to a graphics format much more easily by using a screen capture program. Most screen capture programs allow you to define a rectangle around a portion of the screen, so you can isolate the logo from the rest of PageMaker's interface. Then save the logo in the appropriate graphics format. I find that both the TIFF and PCX formats produce good results. You can use your new logo in any program that imports these formats.

Robert Jober
Ljubljana, Slovenia

►PC MAGAZINE: You're right—screen capture programs are an easy way to generate artwork from PageMaker—or any other program for that matter. Screen capture capability is a ubiquitous feature of the Windows environment. You can use the PrtScr key to capture either a full screen or just the current window to the Windows Clipboard. (Some keyboards may require you to press Alt-PrtScr or Shift-PrtScr.) And a host of utility programs—such as Inset Systems' HiJaak (800-374-6738), Northcoast Software's Conversion Artist (603-664-7871), and U-Lead's ImagePals (310-523-9393) offer sophisticated screen capture and file conversion functions.

However, when you use a screen capture program, you're generating artwork that mirrors the image on your monitor. So you're limited by the resolution of your display—a mere 72 or 90 dots per inch for VGA or Super VGA modes. These low-resolution images may be of

sufficient quality for dot matrix printers, but if your output device is a 300-dpi laser printer or better, you won't be satisfied with the results. In addition, resizing bit-mapped screen shots seriously degrades the quality of the image, because as you enlarge the picture each individual dot becomes proportionately bigger. The resulting pixelation makes diagonal or curved lines look jagged.

In contrast, EPS files, which can be generated by fiddling with the configuration options in the Printer Control Panel, are resolution-independent. Like all PostScript-based images, EPS files will print at the highest resolution of which your printer is capable. And you can resize an EPS image without degrading the quality of the final printout.

Basically the trade-off is between ease-of-use and quality. If graphics at 72 dpi is good enough, a screen capture program should suffice. But if your desktop publishing applications require high-resolution graphics, take the extra time to generate EPS files.—Luisa Simone

BEGINNING DESKTOP PUBLISHING

Q I'd like to create short newsletters for my neighborhood association, but I don't want to buy new hardware just to run Windows. I have a 286 computer with a 40MB hard disk and an HP LaserJet IIP printer. Can you recommend a good desktop publishing program for DOS that would run on my PC?

Dennis Starr
Knoxville, Tennessee

Q I'm looking for a relatively simple desktop publishing package for producing a church newsletter. We have a new 386 computer with an 80MB hard disk and an HP LaserJet IV printer. Do you have any suggestions?

Richard J. Cross
Longmont, Colorado

►PC MAGAZINE: These two questions illustrate the dilemma facing beginning desktop publishers. On the one hand, novice designers need powerful and smart programs with lots of automated effects and on-line help. And on the other

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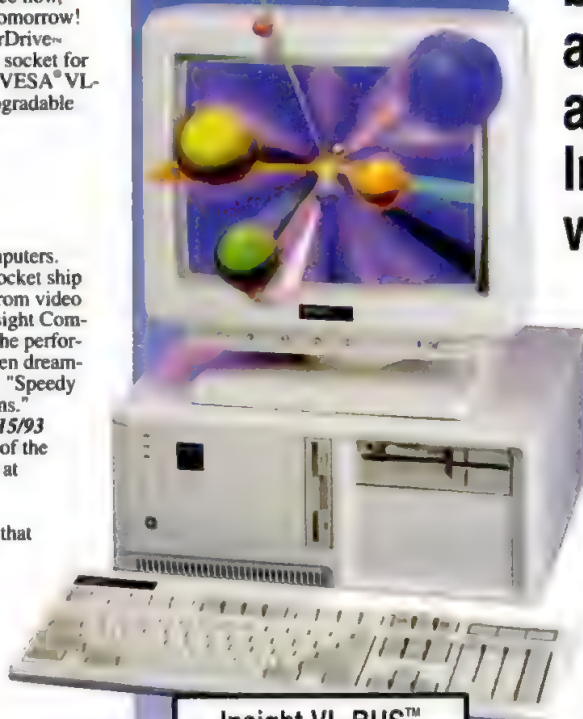
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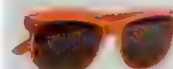


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May 1993

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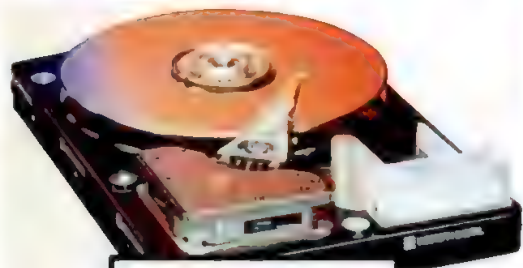
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127MB	17ms	3.5" 1"H
130MB	15ms	3.5" 1"H
170MB	12ms	3.5" 1"H
170MB	17ms	3.5" 1"H
210MB	14ms	3.5" 1"H
210MB	15ms	3.5" 1"H
240MB	9ms	3.5" 1"H
245MB	12ms	3.5" 1"H
250MB	12ms	3.5" 1"H
250MB	11ms	3.5" 1"H
250MB	15ms	3.5" 1"H
340MB	12ms	3.5" 1"H
340MB	15ms	3.5" 1"H
420MB	12ms	3.5" 1"H
452MB	12ms	3.5" 1"H
510MB	12ms	3.5" HH
520MB	12ms	3.5" HH
525MB	11ms	3.5" 1"H
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545MB	10ms	3.5" 1"H
660MB	16ms	5.25" FH
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1000MB	15ms	5.25" FH
1050MB	11ms	3.5" FH
1420MB	15ms	5.25" FH
1900MB	12.9ms	5.25" FH

Manufacturer	Interface	Model#	Bare	16 Bit Kit
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Quantum	SCSI	QUELS85S	219	369
WESTERN DIGITAL	IDE	WD280A	199	219
Seagate	IDE	ST3120A	189	209
Talon	IDE	TA3020A	199	219
Quantum	SCSI	QUELS127S	259	409
Seagate	IDE	ST3144A	199	219
WESTERN DIGITAL	IDE	WD2170A	239	259
CONNER	IDE	CP30174A	249	269
Seagate	IDE	ST3243A	269	289
Maxtor	IDE/SCSI	MX7213A/S	269	289/419
Quantum	IDE/SCSI	QULPS240A/S	359/369	379/519
CONNER	IDE	ST3283A	319	339
WESTERN DIGITAL	SCSI	WD2250A	289	309
Talon	IDE	TA3122A	289	309
Maxtor	IDE	MX7245A	289	309
WESTERN DIGITAL	IDE	WD2340A	359	379
Maxtor	IDE	MX7345A	389	409
WESTERN DIGITAL	IDE	WD2420A	519	539
Seagate	IDE/SCSI	ST3550A/N	529/609	549/759
FUJITSU	IDE	FJ2624A	699	719
FUJITSU	SCSI	FJ2624S	739	889
Seagate	SCSI	ST3600N	759	909
Maxtor	IDE/SCSI	MX540AL/SL	999	1,019/1,149
CONNER	IDE/SCSI	CP30544/0	999	1,019/1,149
Seagate	SCSI	ST4766N	979	1,139
FUJITSU	SCSI	FJ2694S	1,139	1,289
Seagate	SCSI	ST41200N	\$1/MB 999	1,149
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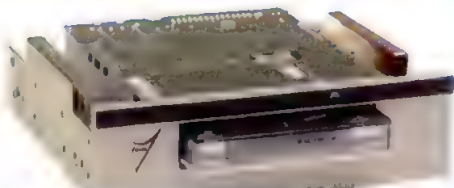
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hand they need programs that won't tax their sometimes limited hardware resources.

If you own a 286-based computer (or even a 386 with 2MB of RAM or less) you *should* purchase a DOS-based DTP program. I'd suggest Power Up Software Corp.'s Express Publisher Version 3.0 for DOS. (Power Up has recently been purchased by Spinnaker Software Corp., but will continue to market Express Publisher for both DOS and Windows. For more information, call 800-851-2917). For the list price of \$124.95 you get a frame-based layout program, 8 scalable fonts, and a built-in module to create special text effects. This latest version of the program also includes a new kind of on-line help: Roger Parker's Layout Advisor is an electronic design consultant that allows you to get advice from an acknowledged DTP expert.

If you have the computing power to run Windows, consider the \$199 Microsoft Publisher, Version 1.0 (206-882-8080), *PC Magazine's* Editors' Choice in the May 12, 1992, issue. Microsoft Publisher is distinguished by PageWizards, which are best described as smart macros that can automatically create customized publications. Microsoft Publisher passed the PC Magazine Labs tests with flying colors, due in part to its stable and extensive range of graphics imports filters and its high-quality printouts. By the time you read this, Microsoft Publisher 2.0 should be ready to ship. Version 2.0 adds several important features, including the ability to save defined paragraph styles, a full-blown table editor, and pop-up help screens that can run mini-tutorials or critique your designs.—*Luisa Simone*

Networking

MANAGING NLMs: A CRITICAL SKILL

❗ Am I missing crucial information on the use of multiple NLMs on the same server? I see companies advertising NLM management software. Can NLMs cause system crashes and if so, why?

*Brad Hayashi
via CompuServe*

► **PC MAGAZINE:** NetWare is a true multi-tasking operating system, which means (in part) that it can execute small portions of many different processes (programs), switching among them so quickly that they seem to execute simultaneously. This facility allows the use of NetWare Loadable Modules—processes that a system administrator can install and run on the file server of NetWare 3.11 and 4.0 systems. The most popular add-ins to the NetWare operating system are database engines for indexing and searching of files, virus protection software that looks for specific virus profiles within files, and

*NetWare 4.0 offers a
method of running NLMs
in a processor area that
will allow them to fail more
gracefully than Ring 0.*

network management programs that report on the server's activities.

On one hand, the server is the best place for these types of programs. They are close to the action and don't have to increase the activity on the network cable to do their jobs. On the other hand, they utilize resources on the server. A database engine can easily occupy more RAM and use more processing power than NetWare itself, and virus scanning programs typically increase CPU utilization by 10 to 15 percent on a fast 386 or 486. As a result, you need to carefully manage NLMs in order to balance their benefits against the added load that they create.

Take a look at NLMAuto from Knoll Systems (800-333-8698 or 602-545-0006) if you want to get rid of idle NLMs dawdling in your LAN. For \$395 per server, this program gives you the power to schedule NLM activity. NLMAuto includes many capabilities for NLM management; one of its more popular uses involves network backup. You can configure the product to unload database NLMs (thus ensuring that all files are closed), start a tape backup NLM, unload the tape when it is finished and reload

the database to start a new day.

When NetWare 3.x came out, much was made of the fact that NLMs run in Ring 0 of the processor, which created the possibility that any misbehaved NLM could take down the entire server. (In protected mode, Intel processors offer four levels of privilege for instruction execution. A Ring 0 program has free rein.) Fortunately this hasn't turned out to be a major problem. Still, server failure is a threat every time you load a new NLM. NetWare 4.0 offers a method of running NLMs in a processor area that will allow them to fail more gracefully, but the change reduces overall performance. Buying NetWare-certified NLMs is the best policy. Really cautious administrators run NLMs on test servers before putting them on the production network.—*Frank J. Derfler, Jr.*

LINKING ETHERNET AND TOKEN-RING LANS

❗ We would like to link our accounting department's 20-node NetWare LAN (which runs over Ethernet) to a 12-station NetWare 3.11 Token-Ring network. Can you advise us about the best way to merge the two?

*Robert Berk
Richardson, Texas*

► **PC MAGAZINE:** A lot depends on the degree of integration you need. Creating the physical link is simple but the administrative problems multiply as you add servers.

The easiest way to physically join your LANs is by popping an Ethernet adapter into your server and running a cable from the new board to the appropriate connection point on the accounting LAN. You'll incur no additional software cost, since NetWare's internal router will move the IPX packets between the Ethernet and Token-Ring networks as necessary.

Connecting with a network that doesn't use NetWare and IPX—LAN Manager using NetBEUI, for example—requires a specialized multiprotocol router. See "Building the Highway" in the March 30, 1993, issue of *PC Magazine* for more information on routers.

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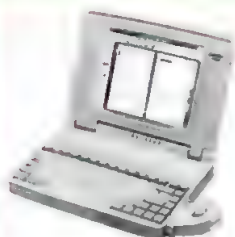


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\$1649*



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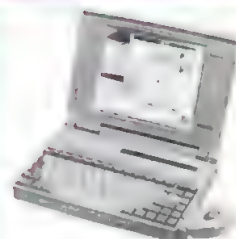
T4500

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- PCMCIA slot
- 6.4 lbs
- MS-DOS, Windows, Trackball

Processor	Hard drive	Price
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\$2029*



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- 2 PCMCIA slots
- 9.5" diagonal display

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- 16-Bit SVGA Card with 512K
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- 5-Bay Mini-Tower Case
- **FREE** Microsoft DOS 6.0 Installed

486SX-33 \$1299

#006301

Statistics:

- VESA Local Bus Motherboard
- 80486SX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 130 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
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- 14" SVGA .28 Non-Interlaced Color Monitor
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486DX2-66 \$2039

#006310

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Statistics:

- VESA Local Bus Motherboard
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- 32-Bit VESA Local Bus IDE Card
- 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
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- 1.44 Mb 3.5" Floppy Drive
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- 14" SVGA .28 Non-Interlaced Color Monitor
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486DX2-66 \$1729

#006304

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- 32-Bit VESA Local Bus IDE Card
- 80486DX-33 Processor
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#006307

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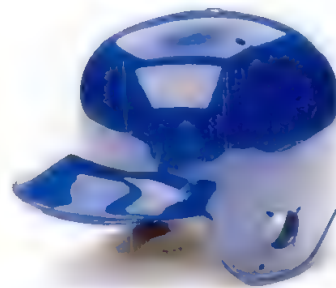
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- 32-Bit VESA Local Bus IDE Card
- 80486DX-33 Processor
- 128K High-Speed Cache
- 8 Mb High-Speed RAM
- 340 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
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#006312

486DX2-66 \$2589

#006313



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Elite 486SLC-33 Notebooks



Elite 486SLC-33 Subnote

When The Game Goes Into Extra Innings, You'll Be Glad You Have An Elite

Not only do the Elite 486SLC-33 Color and Monochrome Notebooks give you more computing power, they give you the power to compute longer. Use the SUSPEND/RESUME feature to avoid unnecessary system rebooting and compute up to 6 hours on a single charge*.

For those afternoon games, the Elite provides a large, non-glare VGA screen that eliminates distortion, flickering and eye strain so you can compute comfortably. Text and graphics appear at 640 x 480 resolution in 64 gray shades or 256 colors.

And if you get caught up in the action, a quick glance at the LCD panel lets you know which drives are being accessed, when battery power is low, what function keys are enabled, whether external power is being used and if there is a modem ring. With the Elite's LCD panel, you'll never feel like you're out in left field.



Elite 486SLC-33 Color

Model	Item #	Price
80 Mb	005461	\$1769
120 Mb	005466	\$1869
200 Mb	005471	\$1979

Statistics:

Processor:
Cyrix 486SLC
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Floppy Drive:
Built-in 1.44 Mb 3.5"
Screen:
Color - 9", 256 colors
Monochrome - 10", 64 gray shades
Video RAM:
Color - 512K
Monochrome - 256K

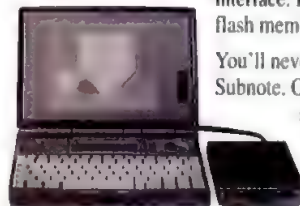
Elite 486SLC-33 Monochrome

Model	Item #	Price
80 Mb	005446	\$1249
120 Mb	005451	\$1349
200 Mb	005456	\$1469

Keyboard:
83 key with 101-key emulation
2-button thumbball mouse
Weight:
Color - 5.7 lbs. with battery
Monochrome - 5.4 lbs. with battery
Battery Life*:
Color - 4 hours
Monochrome - 6 hours
640 x 480 resolution
Simultaneous video
Advanced Power Management
One parallel and one serial interface
External VGA monitor and keyboard connectors
FREE AC adapter carrying case and MS-DOS 6.0 installed
One year manufacturer's warranty

Take Me Out To The Ball Game

Compact and lightweight, the 486SLC-33 fits you like a glove. It weighs only 3.7 lbs and measures 10" x 7" x 1.6", but is more advanced than notebooks twice its size. The Elite 486SLC-33 Subnote comes with a 33 MHz Cyrix processor and 2 Mb of RAM. Need grand slam power? Add an easy-to-install RAM upgrade or take advantage of the latest technology with the Subnote's Type II PCMCIA interface. It allows you to install PCMCIA cards for flash memory, modems and network adapters.



You'll never run out of storage space with the Elite Subnote. Once you fill its 80 Mb removable hard drive, simply take it out and insert another hard drive. There's no limit to the number of hard drives you can fill...or files you can save.

You'd think a small sub-notebook would be hard to work on—but it's not. The Elite Subnote rounds out its bases with a 7.4" high-contrast screen that displays 640 x 480 VGA resolution and 64 gray shades.



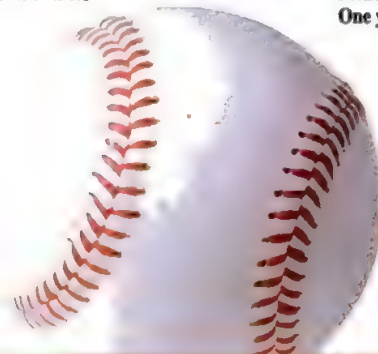
Elite 486SLC-33 Subnote

Model	Item #	Price
80 Mb	005415	\$1379

Statistics:

Processor:
Cyrix 486SLC
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
Removable 80 Mb hard drive
Screen:
7.4" high-contrast screen
640 x 480 VGA resolution
64 gray shades
Video RAM:
256K
Weight:
3.7 lbs. with battery
Size:
10" x 7" x 1.6"

Battery:
Nickel metal hydride battery
Up to eight hours with APM*
Keyboard:
79-key with 101-key emulation
Built-in 2-button trackball
Drag button
Interfaces and Ports:
Parallel and serial interfaces
External keyboard, monitor and modem connectors
External floppy port
PCMCIA Type II slot
Advanced Power Management
Simultaneous video
FREE external 3.5" 1.44 Mb floppy drive,
AC adapter and utilities support disk
FREE MS-DOS 6.0 installed
One year manufacturer's warranty



*Battery life measured with Power Management enabled. Actual battery life may vary.

Elite 486SX/DX Notebooks



Elite 486SX-25 Subnote

With 27 Notebooks to choose from, everyone is a player.

Everyone loves our new line of Elite 486 Notebooks. Choose your Elite with an Intel 486SX-25, 486DX-33 or 486DX2-50 processor, select an active color, dual-scan color or monochrome screen and then pick the hard drive that best meets your needs—from 80 Mb up to 200 Mb!

No matter which processor, screen or hard drive you choose, your Elite 486 Notebook comes standard with 4 Mb of RAM and can be upgraded to 20 Mb.

Isn't it a relief to know that whether you're a teacher, doctor, lawyer, sales representative, student or homemaker, there's an Elite 486 Notebook perfectly matched to your needs...and your budget?

Statistics:

Processor:

Intel 486SX-25, 486DX-33 or 486DX2-50

RAM:

4 Mb, expands to 20 Mb

Hard Drive:

80 Mb, 120 Mb or 200 Mb

Screen:

10", 640 x 480 VGA resolution

Backlit display

Color - 256 colors

Monochrome - 64 gray shades

Battery Life*:

Active Color - 3 hours

Dual-Scan Color - 4 hours

Monochrome - 6 hours

Weight:

Color - 6.9 lbs.

Monochrome - 6.4 lbs.

512K Video RAM

86 keys with 101-key emulation

Built-in trackball

Built-in 1.44 Mb, 3.5" floppy drive

Advanced Power Management

One parallel and one serial port

External VGA and keyboard connectors

One PCMCIA Type III slot/

two Type II slots

FREE AC adapter and utilities disk

FREE MS-DOS 6.0 installed

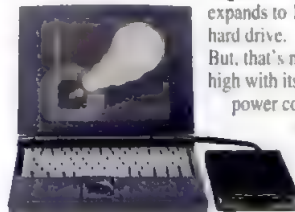


The Best In The Field...

If you're looking for a powerful portable, the Elite 486SX-25 Subnote is a great catch. Weighing a mere 3.9 lbs., the 486SX-25 Subnote features a large 10" VGA screen, 4 Mb of RAM that expands to 12 Mb and up to a 200 Mb hard drive.

But, that's not all! The Elite Subnote scores high with its special Intel processor for low power consumption, Advanced Power Management and PCMCIA Type II slot for modems, flash memory, network adapters and more.

All this for under \$1500? Only at MidWest Micro—so call us today and get your Elite Subnote for peanuts.



486SX-25 Subnote

Model	Item #	Price
80 Mb	005575	\$1499
120 Mb	005576	\$1549
200 Mb	005577	\$1639



Statistics:

Processor:

Intel 486SX

Processing Speed:

25 MHz

RAM:

4 Mb expands to 12 Mb

Hard Drive:

80 Mb, 120 Mb or 200 Mb

Screen:

10", 640 x 480 VGA resolution

Backlit display

64 gray shades

Battery Life*:

5 hours

Weight:

3.9 lbs.

512K Video RAM

83 keys with 101-key emulation

Built-in trackball

External 1.44 Mb, 3.5" floppy drive

Advanced Power Management

One parallel and one serial port

External VGA and keyboard connectors

One PCMCIA Type II slot

FREE AC adapter and utilities disk

FREE MS-DOS 6.0 installed

486SX-25 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	\$1599 #005500	\$2339 #005505	\$3219 #005510
120 Mb	\$1649 #005501	\$2389 #005506	\$3269 #005511
200 Mb	\$1739 #005502	\$2489 #005507	\$3369 #005512

486DX-33 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	\$1869 #005515	\$2599 #005520	\$3489 #005525
120 Mb	\$1919 #005516	\$2659 #005521	\$3539 #005526
200 Mb	\$1999 #005517	\$2749 #005522	\$3629 #005527

486DX2-50 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	\$2089 #005530	\$2839 #005535	\$3719 #005540
120 Mb	\$2139 #005531	\$2889 #005536	\$3759 #005541
200 Mb	\$2239 #005532	\$2979 #005537	\$3859 #005542

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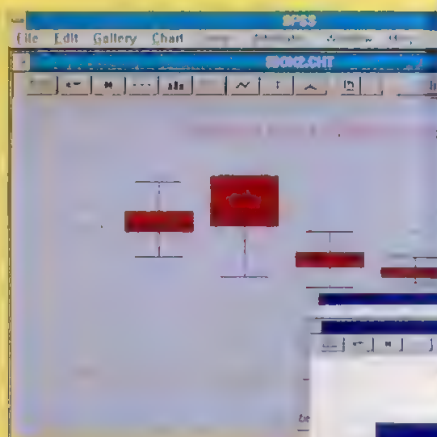
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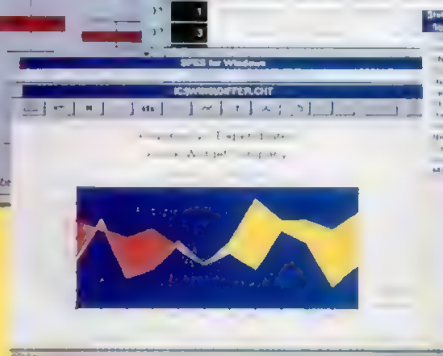
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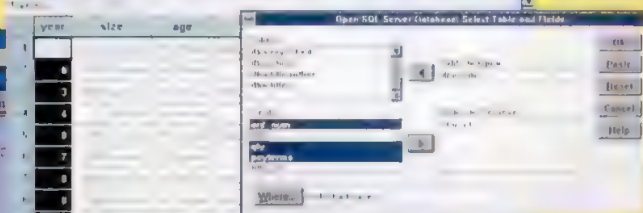
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is only the first step in joining LANs, though. You will have to customize the login scripts for the people in accounting and give them appropriate rights on your server. If you need to give the accountants access to any printers that are attached to your LAN via remote print servers, you can still use a print queue on their file server rather than yours, in order to avoid adding more of a load to your server. Remote print servers—both those that are inside printers and add-on external devices—will service more than one queue. In addition, keep in mind that any server might be the first to acknowledge a node coming on-line, so you are going to have to duplicate the log-in scripts on all of them. Plan on spending several days chasing administrative details after you make the LAN interconnection.

—Frank J. Derfler, Jr.

Languages

SHARING BASIC COMMON VARIABLES WITH ASSEMBLY

TIP Is it possible to access BASIC COMMON variables from an assembly language subroutine? I have tried every combination of COMMON and SHARED in my BASIC program, along with Extn in the assembly language routine, but with no success. I am using BASIC PDS 7.1 and MASM 6. Also, do you know of any books that address advanced topics such as mixing BASIC and assembler?

Michael Lee
Huntsville, Alabama

COMMON.BAS

Complete Listing

```
***** COMMON.BAS *****

'Shows how to access BASIC named COMMON
'variables from an assembly language subroutine.

DEFINT A-Z
COMMON SHARED /MyCommon/ Value1, Value2, Sum

Value1 = 100
Value2 = 250
CALL AddValues
PRINT Sum
```



Figure 8: This short BASIC program, along with COMMON.ASM, shows how to access named COMMON variables from assembly language.

COMMON.ASM

Complete Listing

```
----- COMMON.ASM -----

;Shows how to access BASIC named COMMON variables from an assembly
;language subroutine.

.MODEL Medium, Basic

DGROUP Group MyCommon
MyCommon Segment Common 'BC_Vars'
    Value1 DW 0
    Value2 DW 0
    Sum     DW 0
MyCommon Ends

.DATA
    Var1 DW 0
    Var2 DW 0
    Var3 DW 0

.CODE
AddValues Proc

    MOV AX, Value1
    ADD AX, Value2
    MOV Sum, AX
    RET

;load Value1 into AX
;add Value2 to AX
;assign the result to Sum
;return to BASIC

AddValues Endp
End
```



Figure 9: This short example program, along with COMMON.BAS, shows how to access BASIC named COMMON variables from an assembly language subroutine.

► **PC MAGAZINE:** It certainly is possible to share COMMON variables between BASIC and assembly language, and the key is knowing the correct segment names.

The easiest way to do this is to use a named COMMON block in both the BASIC and assembler source files. Named COMMON is generally more useful than blank COMMON, since each BASIC or assembly language module can access only the variable or group of variables that it needs.

To show the correct way to access

COMMON variables, I wrote the code that is shown in the COMMON.BAS and COMMON.ASM source files. Take a look at Figures 8 and 9 (you can download both source code files from PC MagNet's Programming Forum, archived as COMMON.ZIP).

COMMON.BAS defines a COMMON block with the name MyCommon, and the same segment name is used in COMMON.ASM. As is the case with BASIC-only programs, the variable names do not need to be the same in both modules, but their order and data types are important. In this case Value1, Value2, and Sum are defined as integers in both the BASIC and assembler source files, in that order.

Although the assembly language routine uses the simplified segment-naming conventions introduced with Microsoft's MASM 5.0, you still need to define the COMMON segment manually. You also need to tell LINK that your segment is in BASIC's DGROUP data group. Once you have added the group and segment definitions to your assembly language routine, you can access the same variables from either language. You should note that the initial values that you have specified in the assembler source file (zeros, in this example) are ignored. When the assembly language routine is called, the variables will hold whatever values they had in the BASIC program. □

—Ethan Winer



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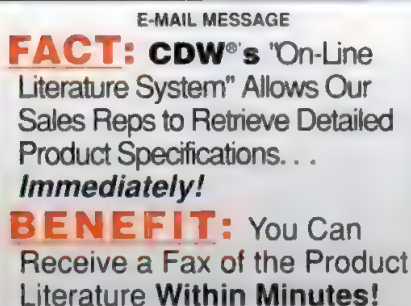


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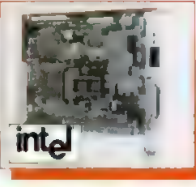
   

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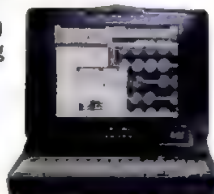
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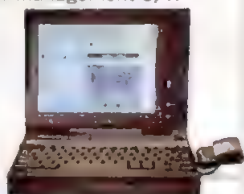
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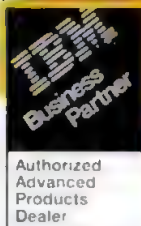
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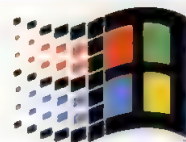
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CODE # PM08A3

CIRCLE 210 ON READER SERVICE CARD

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• 49 KB buffer
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Mail-in Rebate **-\$50**
Your Cost After Rebate ***279**
Offer Ends 7/30/93

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BJ-300 (nar-carr.) ***329** BJ-330 (wide-carr.) ***499**
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BJC-800 (parallel) ***1549** BJC-820 (scsi) ***1859**

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KX-P2124 N-carr., 360 dpi, 12 fonts ***299**
KX-P1624 W-carr., 360 dpi, 7 fonts ***329**
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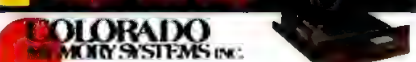
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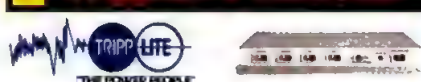
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CIRCLE 033 ON READER SERVICE CARD



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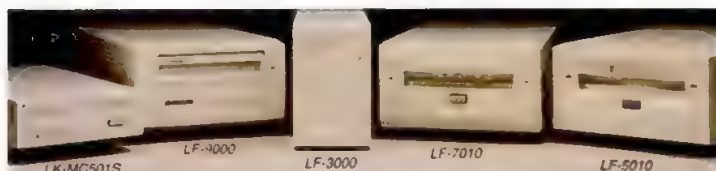
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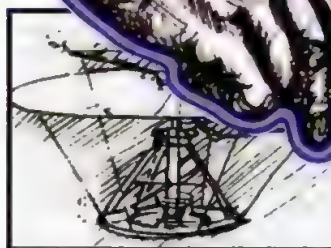
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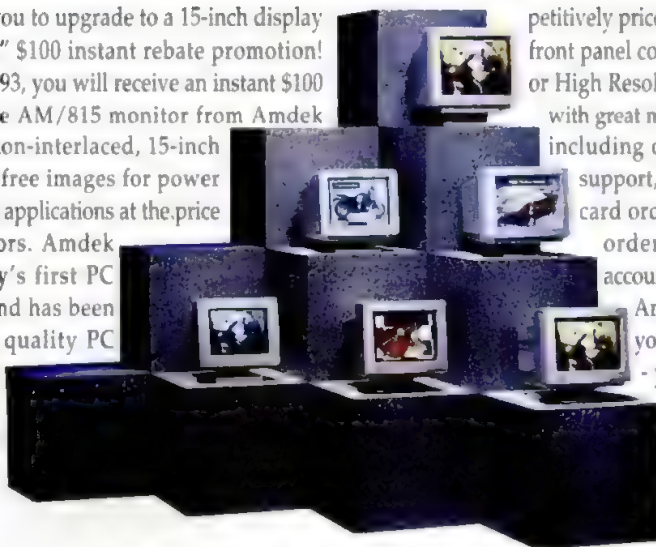
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Max Refresh Rate	60Hz	60Hz	60Hz	60Hz	72Hz	72Hz	72Hz
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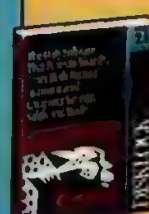
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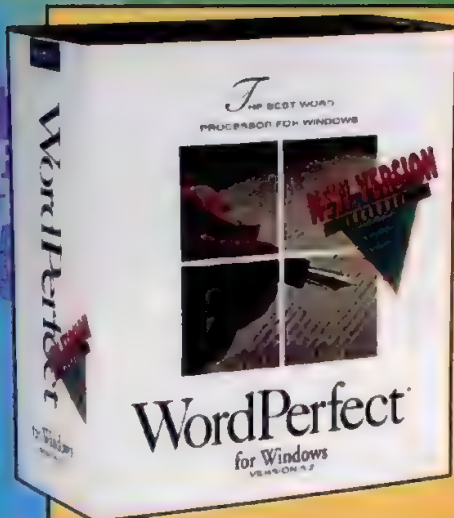
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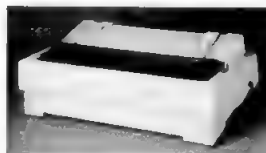
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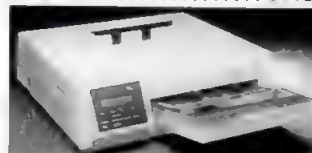
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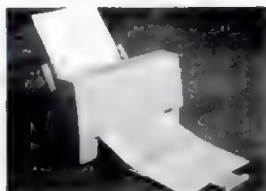
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Macintosh IIx; IIcx			
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Macintosh LC; LCII; Classic II; Performa 200, 400, 600			
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Macintosh Quadra 700; 900; 950			
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32MB	N/A	\$999	64MB N/A
Macintosh IIfx			
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Macintosh Centris 610; 650, LC II			
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16MB	MC15081A	\$999	32MB N/A

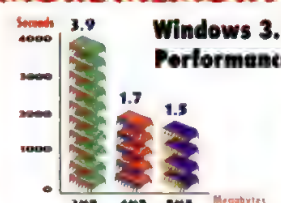
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DeskPro 386x/16			
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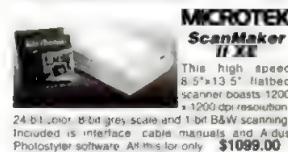
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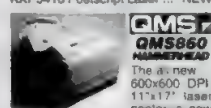
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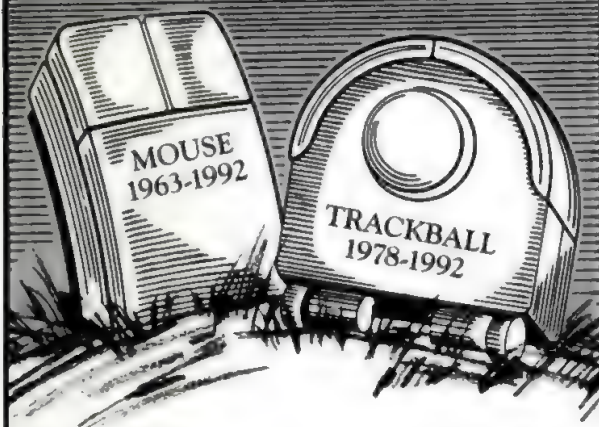
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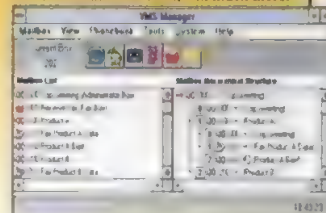


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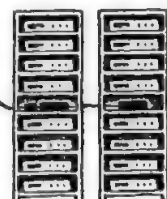
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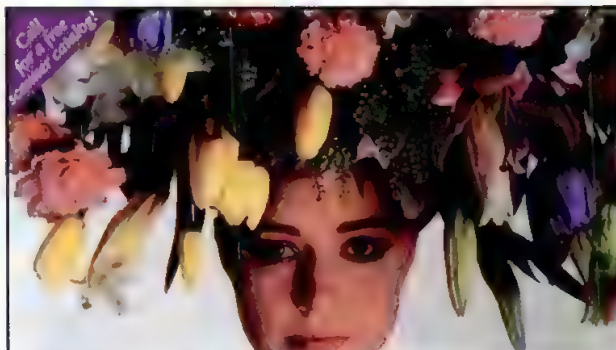
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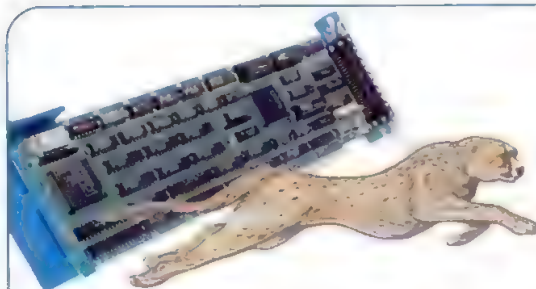
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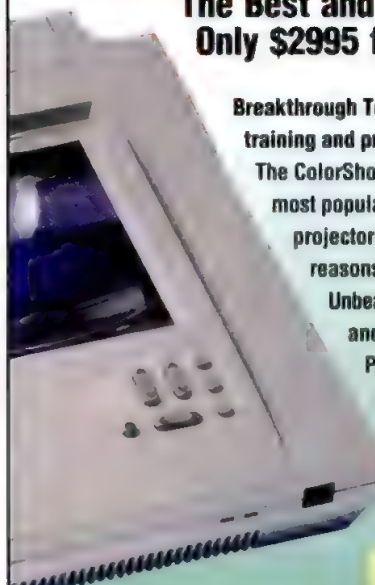
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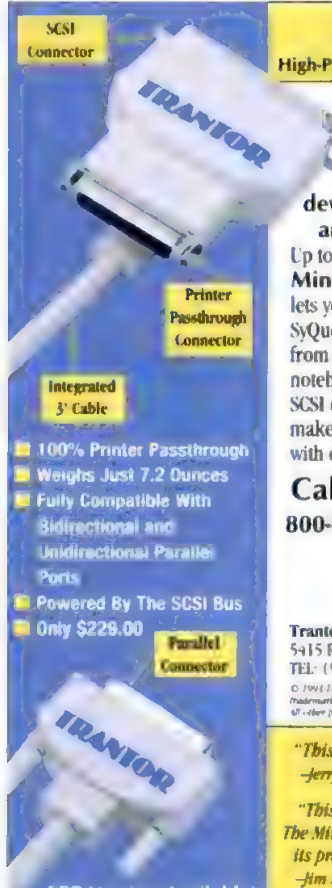


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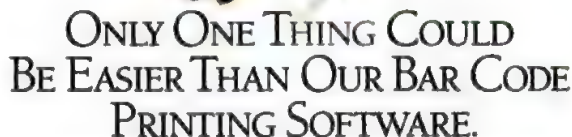
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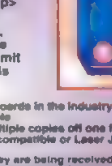
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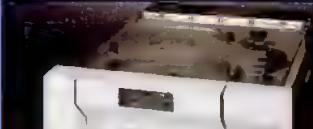
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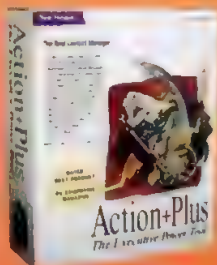
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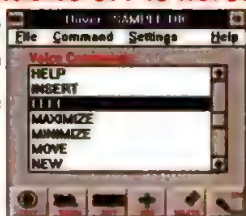
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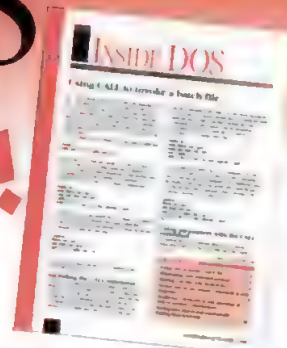
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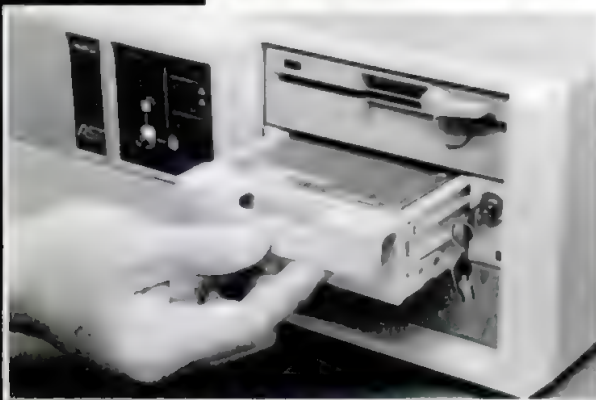
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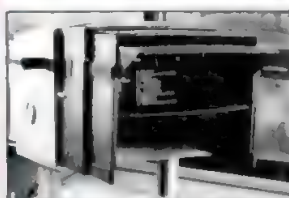


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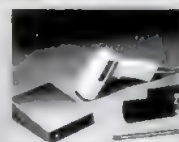
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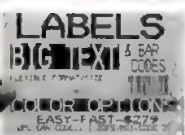
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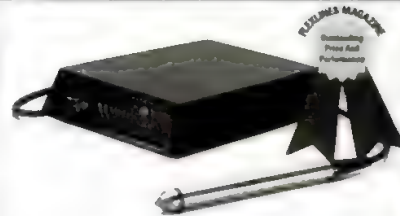
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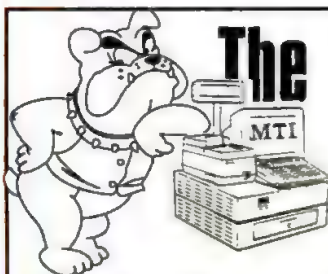
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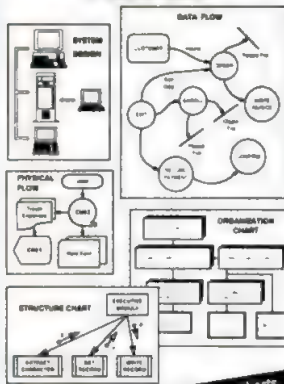
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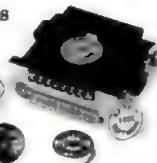
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1. Do you work in a DP/MIS dept.?
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2. Please indicate your company or organization's primary business activity: (Check one)

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- 02. ☐ Manufacturer-Aerospace
- 03. ☐ Manufacturer-Other
- 04. ☐ Systems House
- 05. ☐ Computer Consultant
- 06. ☐ Computer Retailer/VAR/VAD Distributor
- 07. ☐ Communications
- 08. ☐ Finance/Banking/Insurance/Real Estate/Accounting
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- 12. ☐ Research and Development
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17. ☐ Non-Computer Retailer/Dist.
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3. Please indicate your primary business function: (Check one)

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- 10. ☐ Production
- 11. ☐ Education/Training
- 12. ☐ Marketing/Sales
- 13. ☐ Medical/Legal
- 14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

- 01. ☐ 10 or less 03. ☐ 26-99
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

- 01. ☐ Linked to mainframe
- 02. ☐ Linked to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh
- 05. ☐ CD-ROM
- 06. ☐ Windows

8. Do you plan to buy any PC products?

- 01. ☐ Now 03. ☐ In 7 to 12 months
- 02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

- 01. ☐ 25 or less 03. ☐ 100-499 05. ☐ 1000 or more
- 02. ☐ 26-99 04. ☐ 500-999

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2. Please indicate your company or organization's primary business activity: (Check one)

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- 02. ☐ Manufacturer-Aerospace
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- 05. ☐ Computer Consultant
- 06. ☐ Computer Retailer/VAR/VAD Distributor
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- 10. ☐ Government
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- 13. ☐ Medical/Legal
- 14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

- 01. ☐ 10 or less 03. ☐ 26-99
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

- 01. ☐ Linked to mainframe
- 02. ☐ Linked to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh
- 05. ☐ CD-ROM
- 06. ☐ Windows

8. Do you plan to buy any PC products?

- 01. ☐ Now 03. ☐ In 7 to 12 months
- 02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

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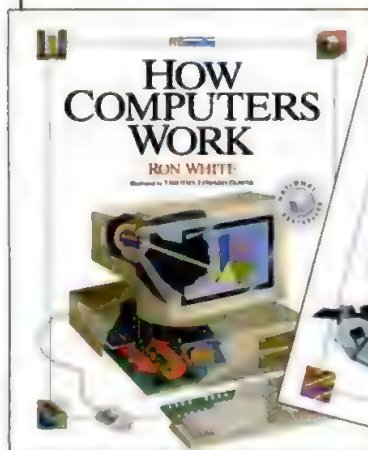
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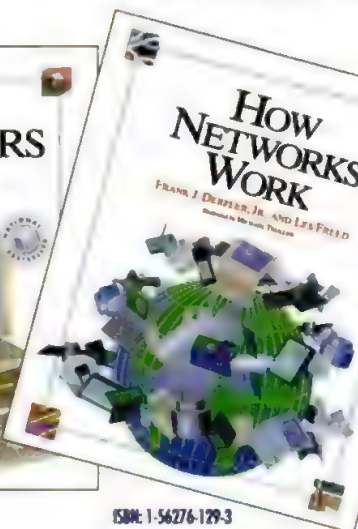
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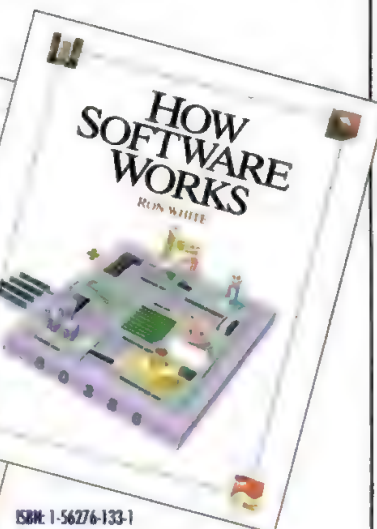
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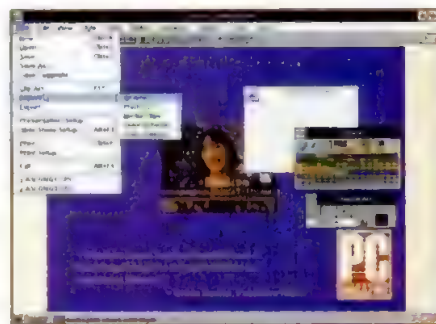
Coming Up

Graphics Hardware

User sophistication and the demands of Windows computing are causing increasing numbers of users to abandon their 14-inch monitors for larger models. Pricing of 17-inch monitors continues to decline, and there are a number of under-\$1,000 models available with attractive performance. We test and review 34 of the current crop of 17-inch monitors that give users a wider view of their data.

Desktop Presentations

Need to add some pizzazz to your presentation? The answer lies in one word—*multimedia*. *PC Magazine* tests three desktop presentation products that can import sound, video, and animation, along with three traditional presentation products that also include multimedia support. All of these packages can help you create a presentation that's guaranteed to grab your audience. We'll help you decide which is the right program for your needs.



PC Magazine reviews six packages that can turn your presentation into a stage show.

Best Utilities

The release of DOS 6.0 (some call it DOS 5.1 with a utility bundle) has inspired more controversy and interest than any software release in recent memory. But just how good are all those utilities bundled with the venerable operating system? *PC Magazine* will answer that question in a follow-up to our April 13, 1993, feature, "DOS 6: The Ultimate Upgrade?" We'll test and compare DOS 6's utilities against the principal market leaders in each category.

Free Utility

Is your screen cluttered with many groups and icons? Is it hard to find the programs you use most often? BTNGO is a Windows 3.x utility that lets you create a button bar with the icons of the programs you run most frequently. And it can float above other 3.1 applications so you don't have to return to the Program Manager to switch to another program. In short, BTNGO makes it easy to run your favorite programs. □

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After Hours

ENCYCLOPEDIAS: Compton's Interactive Encyclopedia for Windows, Microsoft Encarta Multimedia Encyclopedia, The New Grolier Multimedia Encyclopedia; Microsoft Bookshelf 1993

ENCYCLOPEDIAS

The Ideal CD-ROM Reference Library

BY RUBIN RABINOVITZ

A good set of reference materials can save countless trips to a library. Electronic encyclopedias available for the PC meet the needs of elementary schoolers, academics, and even graduates who simply want a set of writing tools.

Here, we cover Compton's Interactive Encyclopedia for Windows, Microsoft Encarta Multimedia Encyclopedia, The New Grolier Multimedia Encyclopedia, and Microsoft Bookshelf 1993.

For young children, Compton's encyclopedia is easiest to use. Encarta's multimedia presentation is top-notch, and Bookshelf supplies a full set of writers' tools: a dictionary, a thesaurus, and books of facts, maps, and quotations. For older users needing a comprehensive product, the Grolier is the program of choice.

COMPTON'S NEWMEDIA INC.

Compton's Interactive Encyclopedia for Windows

Compton's Interactive Encyclopedia for Windows is based on the 26-volume *Compton's Encyclopedia*; it has 9 million words in 33,700 articles. Its writing style and vocabulary are designed for readers from 8 to 15, and its subject matter

is similarly focused: For example, of nine topic headings in the section on literature, three deal with children's literature.

Compton's has other features that make it appropriate for young readers. While it can't perform the conventional Boolean searches, which might prove confusing for children, its retrieval engine supports natural-language inquiries. Entering "Why is the sky blue?" in Compton's Idea Search window takes you to an article on the atmosphere that discusses the blueness of the sky. Yet the Idea Search feature is slow and quirky; some searches take about a minute, and other similarly phrased searches fail.

A Topic Tree provides still another way of getting to the encyclopedia's information. Clicking on one of 19 topics—such as Science, Literature, Law, or Religion—takes you to subtopics and then to specific articles. You can also display an alphabetical table of contents or use buttons to go directly to such features as slide shows, animations, pictures, sound effects, and videos.

Children will find the 60,000-word Merriam-Webster On-Line Dictionary extremely useful for defining words in the encyclopedia's text. There's also a thesaurus

(containing 100,000 synonyms, antonyms, and idiomatic phrases) and a list of foreign expressions commonly used in English.

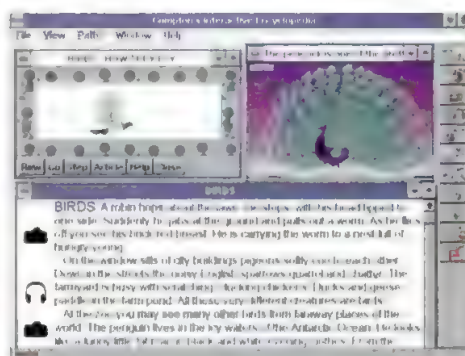
Compton's comes with a variety of audiovisual materials: 13,400 images and graphs, 800 maps, 5,000 charts and diagrams, and 32 short animations illustrating such phenomena as the movement of a snake, seed germination, and the earth orbiting the sun. You can view the animations frame by frame or go through the sequence at normal speed.

The encyclopedia features 30 videos. Subjects include moon exploration, cell division, volcanic eruption, and a speech by President Kennedy. The video screens are small: 160 by 120 pixels, or about 2 by 1.75 inches. You can enlarge them, but if you do, the image quality deteriorates. As with many CD-ROM-based videos, the action and sound

speeches, and sound effects. Compton's also has 32 narrated slide shows on such topics as winter sports, Babylonia and Assyria, the American Revolution, and the seven wonders of the world. But there are problems with the slide shows. Some, like the one on painting, have poor color quality. Others have relatively few slides; the one on Beethoven has only one. And we found that some, like the one on the planets, wouldn't play. Compton's NewMedia hopes to have these problems fixed in the next release.

VIRTUAL DESKTOP

A unique feature in Compton's is the Virtual Workspace, a tool for managing off-screen windows. Using The Virtual Workspace, you can open a series of windows on different topics and move them off screen onto a virtual desktop. The Workspace Map, a miniaturized representation of the desktop, shows icons representing the off-screen windows so that you can locate and display them as needed. In case you need to interrupt your work, a group of Virtual Workspace windows can be saved as a file. The Virtual Workspace is a helpful feature, but it will prove somewhat difficult for



Compton's Virtual Workspace feature lets you keep many different text and graphics windows open at once.

most children to use. There's one real glitch in Compton's: intermittent crashes in high-resolution video modes. While the program may run properly for a

most children to use.

There's one real glitch in Compton's: intermittent crashes in high-resolution video modes. While the program may run properly for a

Compton's

while, a Windows General Protection Fault Error will be triggered occasionally, and you'll have to exit. Compton's NewMedia hopes to have the problem fixed soon and promises that registered owners of Version 1.01VW will be able to get an upgrade of the encyclopedia at no charge (aside from \$4.50 for shipping). Once the bugs are gone, Compton's will resume its place as the online encyclopedia most suitable for younger users.

Compton's Interactive Encyclopedia for Windows, \$395. Requires: 4MB RAM, 2.4MB hard disk space, Microsoft Windows 3.1 with Multimedia Extensions 2.1, CD-ROM drive with 150K-per-second transfer rate. Compton's NewMedia Inc., 2320 Camino Vida Roble, Carlsbad, CA 92009; 800-862-2206, 619-929-2500; fax, 619-929-2577.

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MICROSOFT CORP.

Microsoft Encarta Multimedia Encyclopedia

Surprise! The software giant known for such self-explanatory home-entertainment titles as Musical Instruments, Beethoven, and Golf named its new multimedia encyclopedia Encarta. The title is a made-up word based on a blend of *encyclopedia* and *carta*, a Latin term meaning paper or chart.

Like the name, the product is new as well, differing from the CD-ROM encyclopedias from Compton's NewMedia and Grolier Electronic Publishing, which began as DOS applications. Based on the 29-

volume, 1992 *Funk & Wagnall's New Encyclopedia*, Encarta has some 1,000 contributors and more than 9 million words in 25,000 articles. It features a first-rate selection of audiovisual materials, a time line, an atlas, an 83,000-word dictionary, a 40,000-synonym thesaurus, and a game called MindMaze, in which answering questions based on Encarta's data lets you explore a castle.

UNSIGNED ARTICLES

Encarta will attract an audience somewhere between that for Grolier and that for Compton's. It is less academically-oriented than Grolier, and its articles are unsigned. Many of them have bibliographical references, however. And Encarta is written for a more mature audience than Compton's: While it is advertised as suitable for ages 9 to 15, younger readers will find some articles difficult.

Where Encarta shines is in its extensive collection of high-quality audiovisual materials. Thus, while Grolier and Compton's each have less than an hour's worth of sound, Encarta has seven hours' worth. Encarta's sound clips feature more than 1,000 music segments (including 172 national anthems and 40 music-theory samples), 272 bird and animal sounds, 155 readings, 1,500 word pronunciations, and one unique feature: 900 samples of words and phrases in 46 languages.

Other statistics similarly underline the strength of Encarta's multimedia collection: 45 videos; 142 animations; 7,500 photos, mostly in color; 2,000 illustrations; 1,000 maps; and 290 charts, 100 of them interactive. The article on Rembrandt is accompanied by a self-portrait and 4 of

Rembrandt's other paintings, each displayed when you reach a relevant portion of the text. The article on William Blake includes a portrait, a reproduction of one of Blake's engravings, and a reading of the opening stanza of "The Tiger." The articles on Schubert and Handel each have 2 musical selections; the one on Mozart has 7. The article on Egypt has 4 pictures, 12 sound files, and 2 maps, and the article on the solar system has 9 photos, a chart, and an animation.

MINILECTURES

Encarta's animations, longer, better illustrated, and more sophisticated than those in other encyclopedias, are really minilectures. A narrated animation on color runs almost two minutes and does an excellent job of addressing such issues as the differences between additive and subtractive color. There are equally good animations on such subjects as the dance language of honeybees, the operation of an electric generator, and photosynthesis.

■ Microsoft Bookshelf 1993



A FAVORITE UPDATED: Every reference library needs a solid dictionary, thesaurus, and almanac. A book of quotations and a concise encyclopedia make the bookshelf complete—the goal of Microsoft's popular CD-ROM series Microsoft Bookshelf. The 1993 edition boasts seven reference books: The American Heritage Dictionary, Bartlett's Familiar Quotations, The Concise Columbia Dictionary of Quotations, The Concise Columbia Encyclopedia, The Hammond Atlas, Roget's II Electronic Thesaurus, and The World Almanac and Book of Facts 1993. The almanac is updated yearly and gives up-to-date facts on President Clinton, ethnic cleansing in Bosnia, and other late-breaking news; the other six works are essentially the same as last year's. Microsoft improved its tool buttons by iconizing them and putting them in a movable, hideable box. An ability to export text to Microsoft Word makes this an ideal writers' tool. (Microsoft Corp.; 800-426-9400, 206-882-8080.) Circle 461 on reader service card

Encarta

How does Encarta pack so many multimedia files onto an already crowded CD-ROM disk? Compression is the secret, and Microsoft has licensed file-compression algorithms that are far superior to those in rival programs. Its ADPCM (Analog to Digital Pulse Code Modulation) audio-compression technology achieves 30 percent compression for sound clips; other licensed technologies achieve a 12-to-1 compression ratio for graphics files.

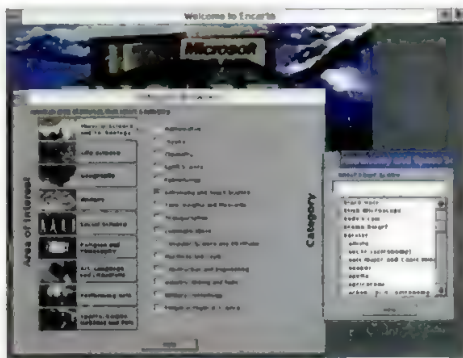
EASIEST TO USE

An elegant interface and straightforward design make Encarta the easiest to use of all the encyclopedias reviewed here. Along with a pair of well-illustrated manuals, there's a tour of the program to get you started and a set of animated help demos. Navigating the program is intuitive, as its components are logically arranged. Encarta's main screens have four primary sections: the Article Frame, which displays the text; the Category Frame, which indicates the topic to which the text pertains; the Gallery Frame, which shows the media items that accompany the articles; and the Main Button Bar, which lets you move to other parts of the program.

Besides providing access to an alphabetical list of the encyclopedia's articles, the Contents button lets you type in first names and initials when you're seeking information about a person. In fact, you'll

find articles on, say, H.G. Wells or F. Scott Fitzgerald more quickly by entering their initials than by typing in their last names.

Long articles can be viewed in full or in an outline mode, which gives main topic head-



Encarta's Category Browser feature makes it easy to go from topic to subtopic as you seek information.

ings and multimedia resources. Clicking on words in the text that are displayed in red brings additional information; there are 27,000 of these hot links. Similarly, pressing the See Also button will take you to related material—not by using conventionally prepared cross-references, but by executing an algorithm designed to link related topics; Encarta has 247,000 of these See Also links.

Browsing through the encyclopedia by topic or alphabetical list is simple. Typing in the first few letters of a word on an alphabetical list will, as in Grolier, take you directly to it. Encarta's Find feature lets you conduct a search through the encyclopedia's text. You can narrow a search by using buttons that set filters for topics, dates, geographical regions, and types of audiovisual material. The Hints button accesses a set of clear instructions on how to conduct a Boolean search; the program's Boolean operators include *and*, *or*, *not*, and *near*, as well as an option for choosing how

close terms should be to invoke the nearness parameter.

Encarta has only a few small flaws: The video playback is jerky on slow systems, finding the numerically coded bibliographic references can be confusing, and many of the program's screens can't be resized. (The latter is a drawback when many items are on-screen and you are trying to customize your work area.)

In most other respects, Microsoft Encarta Multimedia Encyclopedia is an outstanding program. Mature users will appreciate such scholarly features as bibliographies and Boolean searches. Children will enjoy the excellent audiovisual amenities. If color, sound, and motion are important to you, Encarta is the program of choice. Its multimedia features are not only better than those of rival encyclopedias; they're the best of any CD-ROM program now available.

Microsoft Encarta Multimedia Encyclopedia, \$395; annual update, \$79. Requires: 4MB RAM recommended, 7.8MB hard-disk space, CD-ROM player with 150K-per-second transfer rate, Microsoft Windows 3.1 with Microsoft Multimedia Extensions 2.2. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329.

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GROLIER ELECTRONIC PUBLISHING INC.

The New Grolier Multimedia Encyclopedia

The New Grolier Multimedia Encyclopedia is the most comprehensive electronic ency-

clopedia published so far, offering all 10 million words of the 21-volume Academic American Encyclopedia. Of its 33,000 articles, some 7,000 are new or revised to give updated information on subjects such as the political situation in the Persian Gulf and the new Soviet republics.

Grolier comes with 3,000 color and black-and-white photos, about a third of which are current. Thirty-five minutes of sound clips offer music, famous speeches, and animal sounds. A collection of 34 short animations illustrates physical processes such as thunderstorm formation, plate movement in continental drift, and the dynamics of human speech. The animations are offered in the Windows-MPC version of Grolier but not in the DOS version. Each version of the encyclopedia, however, has a selection of 53 video clips showing such scenes as the Apollo spaceship launch and time-lapse photography of flowers opening.

The Grolier package includes an on-line atlas featuring 250 maps that cover the 50 states and the countries of the world. When you display a map, you can instantly get a list of the articles that pertain to it. Although a manual is included with the program, you'll probably need it only to get started; a toolbar with icon buttons makes it easy to choose one of the many methods available for navigating around the encyclopedia.

KNOWLEDGE TREE

If you're looking for general information, you can click on the Knowledge Tree button to move from topic to subtopic. Thus, you might start with History, then progress to United States History, then to International Disputes, and, finally,

Grolier

to an article about the Iranian hostage crisis. Historical information can also be located by using a time line that lists events chronologically; clicking on an item in the time line takes you to the relevant article.

Another button on the toolbar lets you browse through an alphabetical list of article titles; if you're looking for a specific item, typing in the first few letters will take you to it directly. You can also scroll through a keyword list; here, clicking on a word will give you a list of the articles where it's discussed.

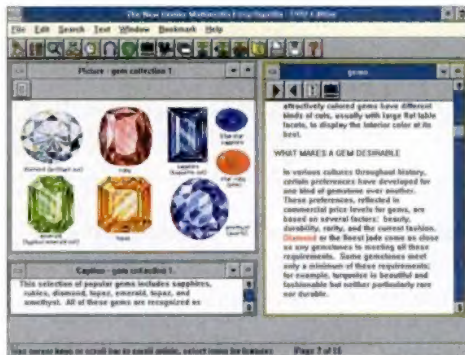
Still another useful option is to run a Boolean search of the entire encyclopedia. For example, if you want to find out about the Supreme Court during Franklin D. Roosevelt's presidency, you can search for the articles referring to both *Supreme Court* and *Roosevelt*, while excluding all of the articles in which references to the name *Theodore* are in proximity to *Roosevelt*.

The MPC version of The New Grolier Multimedia Encyclopedia works best with a fast CD-ROM player (at least a 150K-per-second transfer rate) and an 800-by-600 Super VGA monitor. With a slower CD player, some of the routines can be somewhat choppy. And with a 640-by-480 monitor, some of the maps lose detail, and some illustrations are grainy.

How does Grolier stack up against rival CD-ROM ency-

clopedias? Both Compton's Interactive Encyclopedia for Windows and Microsoft Encarta Multimedia Encyclopedia have a larger stock of audiovisual materials and use a style more suitable for younger users. But Grolier has more text than these two, and its material is designed for those at higher educational levels.

In addition, it has more authoritative articles and superior scholarly amenities, which include bibliographies, fact boxes, tables, and discographies. Many of its 23,000 contributors are recognized experts in their fields. The major



The New Grolier Multimedia Encyclopedia has the most comprehensive and academic text.

articles in The New Grolier Multimedia Encyclopedia are signed, making it possible to determine the stature of a writer. Grolier's more academic approach gives it an edge over the other on-line reference books. □

The New Grolier Multimedia Encyclopedia, \$395; annual update, \$97.

Requires: 2MB RAM, 1MB hard disk space, CD-ROM player, Microsoft Windows 3.1, with Multimedia Extensions 2.21. Grolier Electronic Publishing Inc., Sherman Turnpike, Danbury, CT 06816; 800-285-4534, 203-797-3530; fax, 203-797-3835.

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By Don Willmott

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—*LOTUS MAGAZINE*

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